on GSO links, and then only for certain theoretically possible links having extraordinarily sensitive parameters.

In Document 4-9-11/342, PanAmSat carried out a parametric analysis of GSO links that confirmed that only links with hyper-sensitive parameters would be affected by NGSO FSS interference under the provisional limits. These parameters include:

- Use of extremely low margins to close the link,
- Deployment in desert areas and high altitude places, and
- Extremely high availability requirements.

It is evident from these parameters that such links are not only likely to be extremely few in number, but they can also be easily adjusted (e.g., by using slightly more downlink power) to eliminate any potential problem. Such minor modifications are routinely carried out by GSO systems to account for a constantly changing interference environment independent from any interference that might be generated by NGSO FSS systems. Perhaps most interesting in the Document 342 study was the fact that the study did not identify a single existing link that would be affected by the WRC-97 limits.[96/] While this study is far from conclusive, and does not address the

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[96/] This fact is significant since the analysis of interference from NGSO FSS systems into GSO FSS systems is based on Rec. ITU-R S.1323, an ITU-R recommendation adopted at Radiocommunication Assembly-97. This ITU recommendation is a design recommendation, meant to assist satellite design engineers in constructing links adequate for the interference environment in which they are expected to operate. Thus, once the new version of Rec. ITU-R S.1323 is finalized to accurately define the amount of interference to be expected in the future from NGSO FSS systems, GSO satellite design engineers will take this into account when constructing future systems, just as they now take into account recommendations on intra-service and inter-service

(continued...)

limits proposed by SkyBridge, it is significant in that it shows the extreme cases that must be considered before an impact on GSO FSS systems is encountered.

D. $EPFD_{up}$ Limits

1. Definition

As discussed above, in order to limit the uplink power from NGSO FSS earth stations into GSO satellites, WRC-97 adopted provisional limits on the APFD generated by a given NGSO FSS system. The APFD concept does not, however, take into account the discrimination characteristics of the GSO receive antenna (as is the case with EPFD), and therefore over-estimates the amount of interference that will actually be seen by the GSO antenna. The JTG 4-9-11 has studied this issue carefully, and has tentatively agreed that it is appropriate to add a term to the APFD definition to take into account the GSO receive antenna directivity.[97] In view of the new APFD definition, the JTG agreed to change the nomenclature from APFD to "$EPFD_{up}$," which more accurately reflects the parameter being quantified. SkyBridge fully supports this conclusion, and urges the Commission to adopt the JTG's $EPFD_{up}$ definition[98] in proposed Section 25.208(d)(2), instead of the APFD definition currently proposed in the NPRM.[99]

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[96] (...continued)
interference.

[97] See Document 4-9-11/TEMP/40(Rev.2) (Long Beach).

[98] The complete definition of $EPFD_{up}$ is contained in Appendix 2 of Document 4-9-11/TEMP/40(Rev.2) (Long Beach).

[99] See NPRM at 61-62.

2. Reference GSO Satellite Antenna Pattern

The $EPFD_{up}$ definition requires use of a reference Ku-band GSO satellite receive antenna pattern. The JTG has tentatively agreed to use for this purpose the antenna pattern in Recommendation ITU-R S.672, with a gain of 32.4 dBi, a sidelobe level of -20 dB, and a half-power beamwidth of 4°. SkyBridge agrees with this approach, and proposes that the Commission adopt the JTG agreement.

3. Proposed $EPFD_{up}$ Limits

It is important to note that the revised APFD definition does not in itself necessitate a change in the actual values of the WRC-97 provisional limits. This is because the change only provides a more accurate estimate of the interference into the GSO receiver. SkyBridge proposes that the Commission adopt the WRC-97 provisional limit, referenced to the antenna pattern selected by the JTG.

It was recognized by the JTG that telecommand and ranging carriers transmitted to NGSO FSS systems should not be subject to the $EPFD_{up}$ limits in cases of *force majeure*, due to the possible need for higher power levels to re-acquire a satellite in such emergency circumstances.[100/] SkyBridge proposes that the Commission include this exemption in its rules.

100/ Document 4-9-11/TEMP/65 (Long Beach).

SkyBridge therefore proposes the following $EPFD_{up}$ limits to replace Table ZZ in the Commission's proposed Section 25.208(d)(2):

Frequency bands (GHz)	$EPFD_{up}$ (dBW/m^2)	Percentage of time during which $EPFD_{up}$ level may not be exceeded	Reference bandwidth (kHz)	Reference antenna beamwidth and reference radiation pattern
12.75-13.25 13.75-14.5 17.3-17.8	-170*	100	4	32.4 dBi; 4 deg.; ITU-R S.672, Ls=-20

* Except in the case of telecommand and ranging carriers transmitted to NGSO FSS satellites in the event of *force majeure*, which are exempt from these requirements.

E. Other Considerations

1. Large GSO Earth Stations

WRC-97 adopted provisional EPFD limits for various GSO earth station antenna sizes up to 10 meters in diameter. The NPRM asks whether larger antenna sizes can be protected by EPFD limits (the WRC-97 provisional limits or alternative limits), or whether a coordination procedure would be necessary to protect such antennas.[101/] SkyBridge agrees with the Commission that existing large earth stations should be protected from NGSO interference, and that this issue must be resolved in a manner that does not unduly burden any party.

Large GSO earth stations (e.g., 18 meters in diameter[102/]) are characterized by their high gain, and often extremely high availability requirements. Due to the high gain, the concern is whether Recommendation ITU-R S.1323, particularly the sync loss criteria,[103/] will be met. However, because establishing special EPFD limits or coordination procedures for these facilities could dramatically constrain NGSO FSS systems, a careful assessment of the special case of large earth stations is merited before doing so, to prevent unnecessarily burdening NGSO systems.

101/ NPRM, ¶ 27.

102/ It should be noted that the only operator in the United States to raise concern with respect to an earth station greater than 10 meters in diameter, the Department of Defense, operates its earth stations (in this case, 18 meter) in the Ka-band, and not in the Ku-band. Documents 4-9-11/281 and 4-9-11/285.

103/ Rec. ITU-R S.1323 recommends that aggregate NGSO interference should not lead to loss of synchronization more than once per x days, with x to be determined by further studies. See Section III.A.1 above.

To assess compliance with Recommendation ITU-R S.1323 for large earth stations, one must look at the probability of the occurrence of an NGSO sidelobe in-line with the main beam of a large earth station, and the duration of such events. As described above, an NGSO system, such as SkyBridge, must meet the EPFD limits at all points on Earth and for all GSO earth station pointing directions. Earth stations not located in this worst-case configuration will experience significantly lower maximum EPFDs.[104/] Furthermore, because the occurrence of a worst case interference event for a SkyBridge-type system is the result of an NGSO satellite crossing the main beam of the GSO earth station with the NGSO spacecraft beam sidelobe at the maximum level, the probability of such occurrence is proportional to the beamwidth of the earth station. SkyBridge's analysis indicates that for large earth stations, the localization of the worst-case EPFD values is extremely pronounced, with a sharp drop off of several dB's in the worst-case EPFD for earth stations in areas immediately surrounding that location.[105/] Given the very small numbers of such antennas (the JTG has invited administrations to provide data on large dishes so that this number can be quantified[106/]), the chance that such an antenna will be sited in

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[104/] The worst case location is dependent on the specific NGSO system considered. See Document 4-9-11/246. For the SkyBridge System, the worst case GSO location is at 42.5 N Latitude and 53.5 E longitude, pointing toward a GSO satellite at 81 E. See supra note 82.

[105/] Document 4-9-11/268.

[106/] See Document 4-9-11/TEMP/63(Rev.1) (Long Beach).

the worst-case location, and thus be susceptible to the worst-case EPFD, is truly insignificant.[107/]

Furthermore, the maximum duration of such events is reduced as the antenna size increases, because the time spent by the NGSO satellite in the main beam is reduced. All these characteristics need to be fully considered[108/] before concluding that any existing large earth station would actually suffer harmful interference from NGSO FSS.

It is important that the studies be concluded before any coordination requirement is introduced. This is because a full understanding of the phenomenon is necessary in order to determine the appropriate means for solving any problem, should one be identified. As discussed at the recent JTG 4-9-11 meeting in Long Beach, establishing a coordination regime can be fraught with difficulties:

- The very large earth stations of concern are often not notified to the ITU. The burden on NGSOs of coordination, and even the feasibility of success in such coordination, is therefore extremely hard to determine. In addition, the lack of ITU or national filings for such systems makes it difficult to establish a sunset date after which coordination would no longer be required.

[107/] Even if an earth station was located at or near the worst-case location, the natural perturbations in station-keeping of both GSO and NGSO antennas, which are not synchronized, and the extremely narrow beamwidth of large antennas, will act to reduce the chance of in-line encounters. Document 4-9-11/186.

[108/] In particular, there is a need for detailed simulations using actual GSO and NGSO parameters and a sufficiently small time step to ensure that all in-line events are captured, and that the large variations in EPFD due to the high directivity of such dishes are captured. SkyBridge will continue its work on such simulations (assuming it is able to obtain all relevant GSO parameters) and will keep the Commission and relevant ITU-R study groups apprised of its progress.

- Even if the GSO system has been notified to the ITU, the antenna operator would be required to provide sensitive, in some cases classified, information in order to coordinate, and this information would need to be published by the ITU Radiocommunication Bureau to ensure the required transparency in the process. The NGSO operator would also have to provide commercially-sensitive data.

- Any coordination requirement could lead to the situation of an NGSO FSS system being "held hostage" worldwide because of a very local issue with a potential competing service provider.

- The concept of a coordination trigger creates a slippery slope, threatening the Commission's proposed regime of power flux-density hard limits.

For these reasons, a coordination requirement should only be imposed in response to a definitive showing of harm to an identifiable class of large earth stations. Such a showing does not exist to date.

As it has done in the past, SkyBridge will work within the ITU-R study groups and with the Commission to further assess the impact of NGSO FSS systems to large earth stations. The JTG has undertaken the work needed to analyze the specific case of large earth stations. As noted above, a circular letter has been sent to all administrations in order to gather the information necessary to allow WP 4A to draw technical conclusions and propose adequate protection measures. If it is determined that a coordination procedure for certain large earth stations is required,[109/]

[109/] Such coordination is necessarily an international issue. It is quite possible for the problematic configuration -- sidelobes of the NGSO satellites transmitting into the main beam of large earth stations -- to occur with a GSO earth station in one country and NGSO satellite beams serving another country. This is the case even if the NGSO system does not serve the first country. See NPRM, ¶ 96.

SkyBridge will work to develop the appropriate procedure and triggers for such coordination.[110/]

2. Inclined-Orbit GSO Systems

The Commission has also requested comment on the protection that should be extended to GSO FSS earth stations receiving signals from GSO satellites in slightly inclined-orbits.[111/] Such orbits are used by GSO operators to extend the life of a satellite by preserving station-keeping fuel. The degree of inclination is generally less than 5°, and more commonly on the order of 3° or less.[112/]

It should be noted that under current Commission rules, licensees operating in inclined orbits may not claim any protection in excess of the protection that would be received in non-inclined orbit, and cannot cause more interference to adjacent satellites as a result of operating in an inclined orbit.[113/] Notwithstanding this long-standing status of slightly-inclined orbit systems, the Commission now proposes to require NGSO FSS systems to protect a certain degree of inclination, and requests comment on what that inclination angle should be.

SkyBridge's studies to date have indicated that NGSO systems that employ satellite diversity to avoid the GSO arc inherently provide significant

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110/ If a coordination procedure is established, it should apply only to existing and planned GSO earth stations, and the procedure should not prohibit the notification to the ITU of the NGSO FSS network pending coordination agreement.

111/ NPRM, ¶ 27.

112/ See Documents 4-9-11/79 and 4A/31 (Rev. 2).

113/ 47 C.F.R. § 25.280(b).

protection to GSO satellite systems using slightly-inclined orbits. The SkyBridge System, for example, would protect GSO earth stations tracking orbits inclined up to 3° to substantially the same flux levels as for non-inclined systems, and would provide minimal degradation for orbits inclined up to 5°.[114/]

Moreover, there has been no showing that the protection criteria of Recommendation ITU-R S.1323 would fail to be met for any link to a slightly inclined-orbit link. No specific link budgets for communication with inclined-orbit GSO satellites, nor the protection requirements of such systems, have been identified in the JTG process.

As the Commission has noted, protection of satellites in large inclined orbits could hamper NGSO system capacity.[115/] To require co-primary NGSO systems to protect larger inclinations to the same degree as non-inclined systems would place significant capacity and cost constraints on such systems, which are already paying a

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114/ See Document 4-9-11/270. The SkyBridge simulations have been performed for 3 meter GSO earth stations. Studies on larger earth stations are ongoing. See also Document 4-9-11/334 (concluding that the WRC-97 provisional limits provide protection to 10 meter GSO earth stations operating to satellites inclined up to 4°). The protection afforded by other NGSO system architectures, and the burdens on NGSO systems of guaranteeing the same level of protection to a specified degree of inclination, has yet to be ascertained. However, SkyBridge fully expects that other NGSO architectures will provide protection to inclined-orbit systems similar to that provided by the SkyBridge System, as a consequence of the GSO-arc avoidance techniques already employed. SkyBridge knows of no NGSO FSS system proposing to operate in the subject bands that does not employ arc avoidance as at least one of the forms of mitigation used to protect GSO systems.

115/ NPRM, ¶ 27.

very large price to protect non-inclined orbit systems.[116/] In order to avoid a reduction in capacity, protection of slightly-inclined systems according to the same standards as non-inclined systems would require an increase in the number of NGSO satellites, in order to increase the size of the GSO exclusion zone worldwide.

In the absence of any studies demonstrating harm to any slightly-inclined GSO system by NGSO FSS systems, and in view of the substantial evidence that they will be inherently protected by the measures already taken to protect non-inclined systems, SkyBridge urges the Commission to refrain from imposing a special requirement for the protection of slightly-inclined systems. Such a requirement would unnecessarily burden NGSO FSS systems, and would not be consistent with the Commission's long-standing policy toward slightly-inclined orbit systems.

3. GSO TT&C

(a) Operational Orbit

Studies in JTG 4-9-11 generally conclude that GSO command and telemetry links will be protected by the WRC-97 provisional limits in the normal mode of operation.[117/] However, as the Commission points out,[118/] one document submitted to the second meeting of JTG 4-9-11 stated that "it is possible for some telemetry downlinks to be degraded below the threshold, however, such occurrences

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116/ See Section III.C above.

117/ Document 4-9-11/211.

118/ NPRM, ¶ 30.

would be of very low probability."[119/] This conclusion was reached using very pessimistic assumptions (e.g., successive worst-case assumptions, "static" link budgets). Moreover, the study ignored the fact that telemetry parameters are inserted in repetitive frames, and any short-term loss of the link is compensated for by the interpolation of the parameters transmitted before and after the loss. As a consequence, any short-term interference event, if it should occur, would not have a detrimental impact on TT&C operations.

SkyBridge is of the view that the EPFD and $EPFD_{up}$ limits proposed herein adequately protect GSO command and telemetry links in normal mode of operation, and that no additional measures are required.

(b) Transfer Orbit

With respect to protection of GSO TT&C operations during transfer orbits, the Commission proposes that GSO (FSS and BSS) and NGSO FSS licensees consult with each other to ensure successful deployment of the GSO spacecraft and operation of the NGSO system.[120/] SkyBridge made a similar proposal at the first meeting of JTG 4-9-11[121/] and strongly supports the Commission's proposal.

(c) Emergency Situations

The Commission has also requested comment on how to protect GSO TT&C operations in emergency situations, where a GSO operator is attempting to require and regain control of a GSO satellite.

119/ Document 4-9-11/140.

120/ NPRM, ¶ 29.

121/ Document 4-9-11/17.

SkyBridge is of the view that, in case of *force majeure*, any operator (GSO or NGSO) should be permitted to use all means at its disposal to reacquire communications and regain control of its spacecraft. The last meeting of JTG 4-9-11 endorsed this idea, proposing that in cases of *force majeure* telecommand and ranging carriers transmitted to GSO or NGSO FSS systems should be exempt from the off-axis EIRP limits in Article S22, and that NGSO FSS systems should not be subject to the $EPFD_{up}$ limits.

As in the case of transfer orbit, a dialogue between operators (GSO and NGSO), on a case-by-case basis is needed to facilitate the resolution of any *force majeure* event.

4. NGSO Failures

The Commission requests comment on how to protect GSO operations from malfunctioning NGSO satellites.[122/] This situation is really no different than that in the GSO context, and should be treated similarly.[123/]

As SkyBridge discussed in its Application[124/] and its opposition to petitions to deny its Application,[125/] several safeguards will be built into the SkyBridge System to limit the failure modes, and to fully protect GSO and FS systems in the

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122/ NPRM, ¶ 31.

123/ The ITU Radio Regulations and the Commission's rules address this concern by requiring that space stations (GSO and NGSO) be made capable of ceasing radio emissions by use of appropriate devices. See ITU RR Article S22.1; 47 C.F.R. § 25.207.

124/ See, e.g., SkyBridge Application at 72.

125/ Opposition of SkyBridge, File Nos. 48-SAT-P/LA-97, 89-SAT-AMEND-97, at 25.

event of failures. Any failure that could theoretically adversely affect another system would necessarily severely impact the operation of the SkyBridge System, and cause the system to react rapidly. The situation can be expected to be the same for other NGSO FSS systems as well. Thus, as is the case with GSO systems, there are sufficient incentives to avoid failures, and the impact of such failures on other systems. No additional regulatory procedures or requirements are required to ensure NGSO satellite failures do not burden other services.

IV. NGSO FSS SHARING WITH GSO BSS

WRC-97 also adopted provisional single entry EPFD and APFD limits for the protection of GSO BSS systems. Resolution 538 of WRC-97 called for a review of these provisional limits. JTG 4-9-11 and JWP 10-11S have been conducting the necessary studies to assess the adequacy of those limits to protect GSO BSS operations, without imposing undue burdens on NGSO FSS systems. The areas of study parallel those for GSO FSS, and the principles for deriving and confirming limits are similar for both cases.

SkyBridge sets out below the results of these studies, and uses the results to derive EPFD masks for protection of GSO BSS systems.

A. Results of ITU-R Studies

JWP 10-11S has developed a Preliminary Draft New Recommendation ("PDNR")[126/] for the protection criteria for BSS systems, which has been used by the JTG 4-9-11 in its work to-date. In its most current draft form, including proposed changes by the JTG, this recommendation proposes that all NGSO systems (in the aggregate) should:

- be responsible for at most 10% of the time allowance(s) for unavailability of the given C/N value(s) as specified in the performance objectives of the desired network, where N is the total noise level of the wanted carrier including all other non-time-varying sources of interference, and
- not lead to onset of "freeze frame" in a digital BSS link under clear sky conditions.[127/]

126/ Document 4-9-11/217.

127/ See Document 4-9-11/TEMP/93, Annex 6.

The methodology in the 10-11S PDNR to derive and assess candidate EPFD limits is similar to that discussed above for Recommendation ITU-R S.1323. JWP 10-11S has established a database of GSO BSS links[128/] that the JTG has agreed to use to assess the adequacy of candidate limits to protect BSS operations.[129/]

As for the GSO FSS limits, JTG 4-9-11 has concluded that the EPFD limits for protection of GSO BSS links should take the form of continuous EPFD masks (defined for all time percentages) shaped to fit the statistical nature of NGSO FSS interference.[130/] Such masks address the need of BSS operators for limits governing the true "long-term" situation.

SkyBridge proposes that the Commission follow the lead of the ITU-R study groups and adopt these proposals for the purposes of establishing EPFD masks to be included in the Commission's rules.

B. EPFD Limits

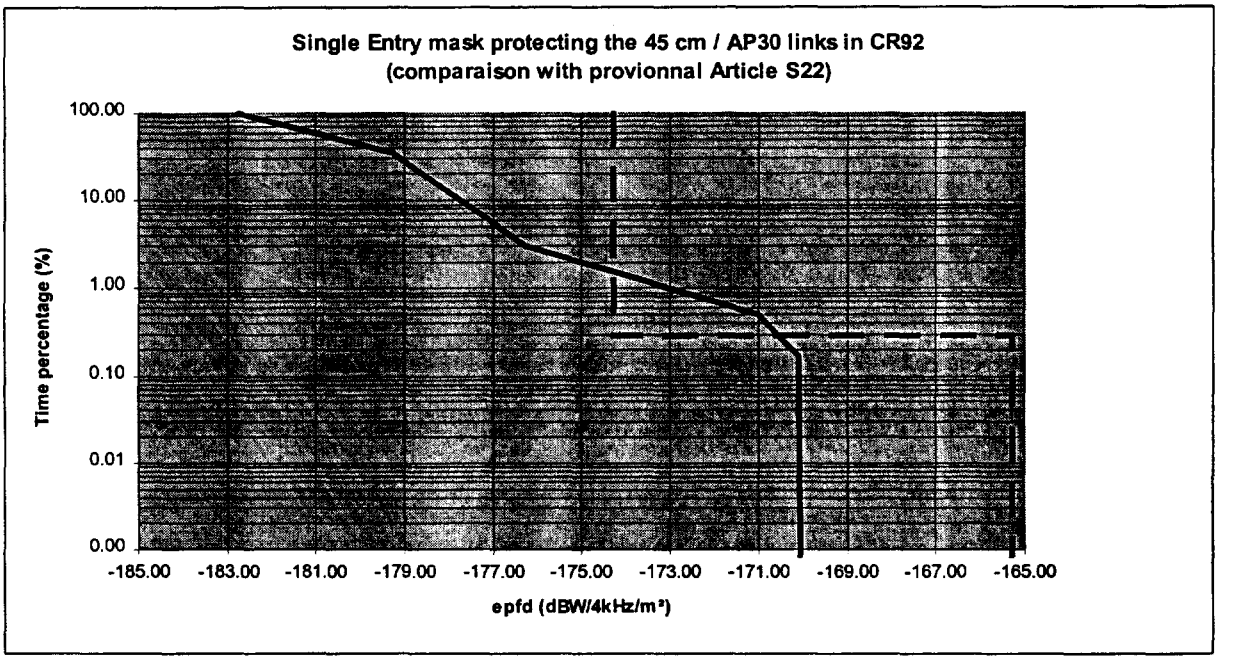
Employing the ITU-R methodology and techniques, SkyBridge has derived aggregate EPFD masks, which are then used to derive single entry EPFD masks that adequately protect GSO BSS systems within the dictates of the 10-11S PDNR, while accommodating entry of multiple NGSO FSS systems in the band. The details of these derivations are contained in Appendix B.

128/ The latest version of this database is contained in Document 4-9-11/TEMP/74 (Long Beach).

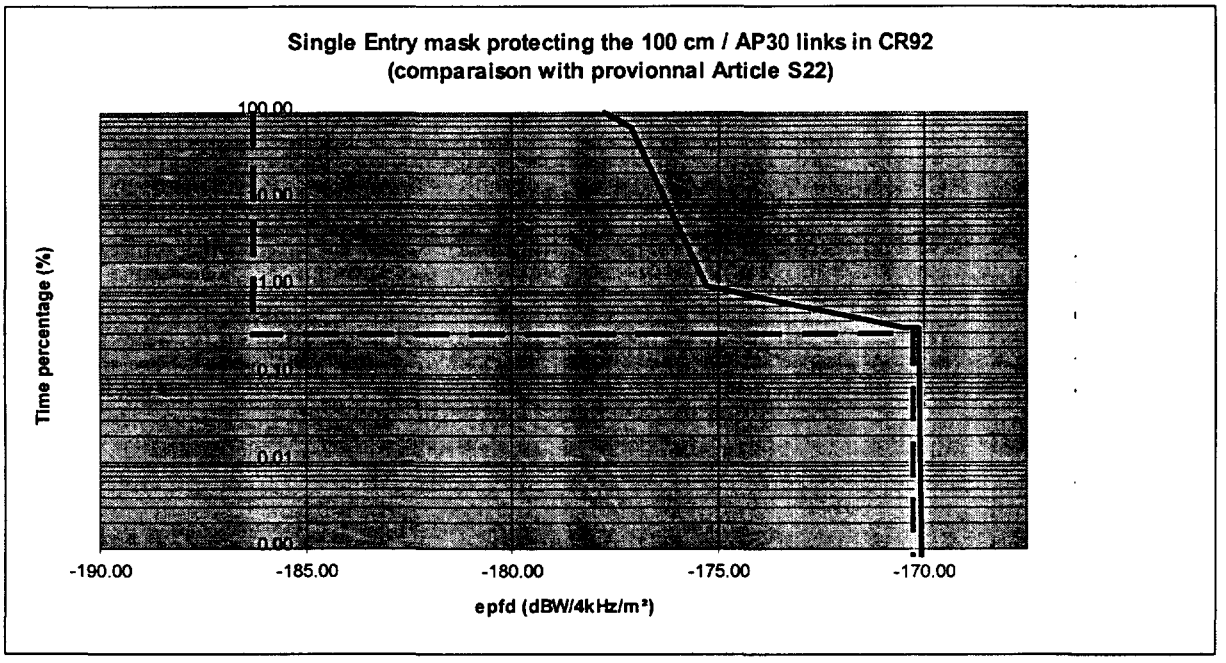
129/ Document 4-9-11/TEMP/93 (Long Beach). As in the case of the GSO FSS database, the JTG has established a deadline of March 15, 1999 for submissions.

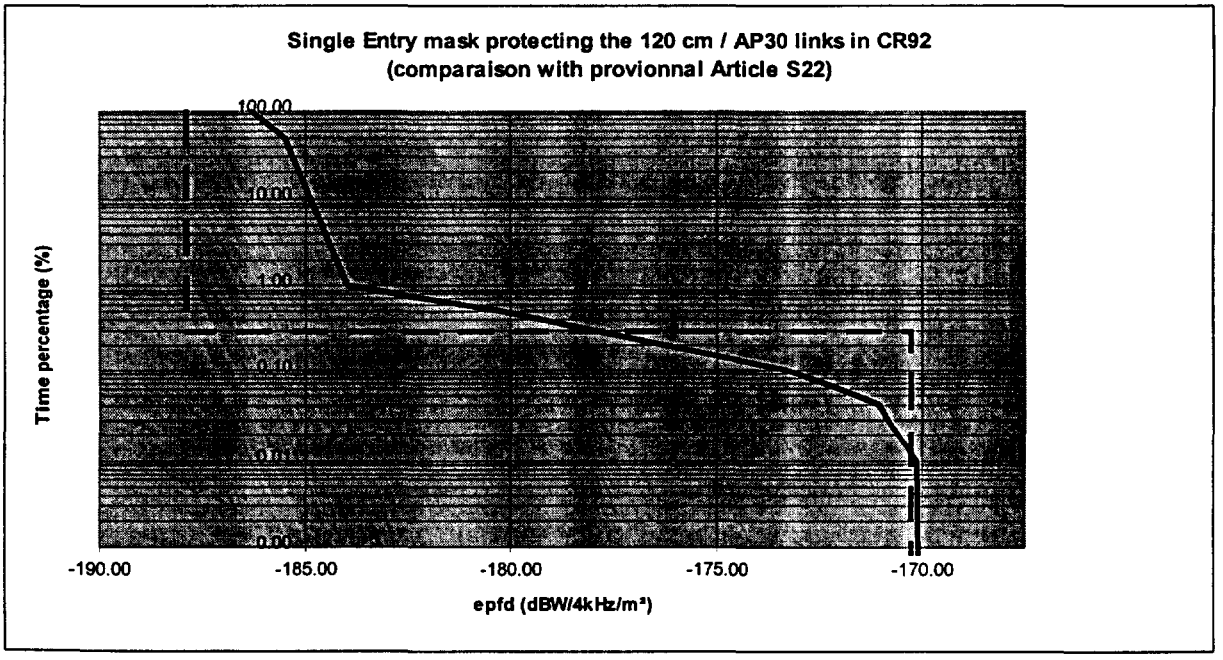
130/ See Recommends 2.3 of the JWP 10-11S PDNR; Document 4-9-11/TEMP/93 (Long Beach).

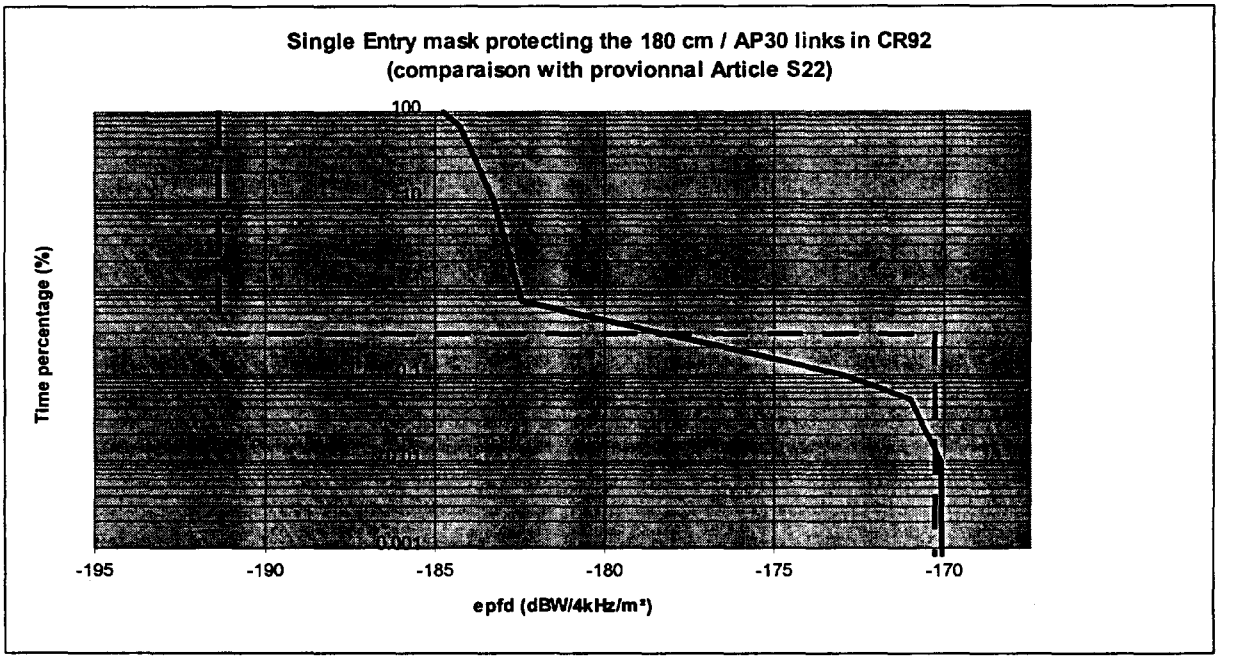
SkyBridge proposes the following single entry EPFD masks for 45 cm, 100 cm, 120 cm, and 180 cm GSO BSS reference antenna sizes for Region 2:[131/]



131/ As discussed in Section VII.D.3, infra, the JTG has proposed GSO reference antenna patterns to be used in the definition of EPFD. The Commission should correlate SkyBridge's proposed EPFD masks with the reference antenna patterns ultimately adopted by the JTG.


Single Entry mask protecting the 100 cm / AP30 links in CR92
(comparaison with provionnal Article S22)
Time percentage (%)
100.00
1.00
0.01
0.00
-190.00
-185.00
-180.00
-175.00
-170.00
epfd (dBW/4kHz/m²)


Single Entry mask protecting the 120 cm / AP30 links in CR92
(comparaison with provionnal Article S22)
Time percentage (%)
100.00
1.00
-190.00
-185.00
-180.00
-175.00
-170.00
epfd (dBW/4kHz/m²)


Single Entry mask protecting the 180 cm / AP30 links in CR92
(comparaison with provionnal Article S22)
100
10
1
0.1
0.01
Time percentage (%)
-195
-190
-185
-180
-175
-170
epfd (dBW/4kHz/m²)

It is important to note that these masks have been derived based on the links currently contained in the CR 92 database. As noted above, that database will close on March 15, 1999, and it is anticipated that administrations will file additional links by that date. Therefore, the derivations contained in Appendix B will be revisited by SkyBridge once all of the relevant links have been provided.

It is important to consider the conservative nature of the assumptions that are made in the methodology used to (1) derive the EPFD limits and (2) assess whether a given NGSO system meets the limits. As discussed in detail in Section III.C.1 above, the EPFD limits will necessarily represent a significant over-estimation of the impact of any given NGSO FSS system, causing an artificially pessimistic assessment of the actual unavailability reduction to GSO links. The Commission must be cognizant of this fact in devising the limits contained in its rules to ensure that it does not inadvertently impose an undue burden on either GSO or NGSO systems. The Commission should also take into account the burdens of the features already employed by NGSO FSS systems to protect BSS systems, and the costs of additional features or reductions in capacity, described in Sections III.C.2 and 3 above, that would accompany any tightening of the limits proposed above.

C. Other Considerations

1. Airborne BSS

The NPRM notes that DirecTV plans to provide DBS services to antennas mounted on aircraft.[132/] According to DirecTV, these antennas tend to have wider beams in elevation than in azimuth, sometimes significantly wider. The

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132/ NPRM, ¶ 61.

Commission asks whether this type of use is consistent with the Commission's rules and whether it is appropriate to protect this kind of reception.

As SkyBridge has noted in the past, it is not at all clear that this proposal is consistent with the existing allocation for the 12.2-12.7 GHz band. Moreover, given the ancillary nature of the service in any event, imposing additional constraints on NGSO FSS systems merely to protect airborne DBS services could not be justified under the "undue constraint" standard.

However, it appears at this juncture that airborne BSS services and NGSO FSS systems could co-exist under the presently proposed technical parameters. Obviously, further study, based on a full description of the relevant links, would be critical to making a rational final determination on the matter.[133/] Based on currently available information, though, there appear to be several reasons why such links should be compatible with NGSO operation. First, the lobes of the antennas are mainly in the azimuth and elevation plane with some discrimination in the other directions. Furthermore, the low directivity of the antennas also acts to increase the interference from adjacent GSO satellites, increasing the system noise temperature. This sensitivity to other sources of interference requires higher margins. As noted above, further study will be necessary.

133/ Although some link budgets for airborne antennas are incorporated in the CR 92 database (links US-GSO D5(a) and US-GSO D5(b)), key pieces of information are missing (e.g., on-axis gain and availability objective) that are necessary to assess whether there is any incompatibility between such operations and NGSO FSS systems.

2. Future BSS Systems

The Commission states in the NPRM that NGSO FSS operations should not hinder evolution of BSS services (e.g., high definition television signals, one-way data services, use of smaller or non-symmetric receive antennas), and requests comment on the impact of the WRC-97 provisional limits on such future services.[134/] SkyBridge agrees that improved BSS service should not be stifled by the Article S22 limits.

However, it must be kept in mind that future systems, as opposed to existing systems, can plan for the NGSO FSS environment, and take such systems into account in developing link budgets for future BSS systems. The interference caused by NGSO FSS systems will be very clearly defined by the Article S22 limits, and therefore this effort should be quite straightforward, and not significantly burden BSS system designers.

Furthermore, any evolution of BSS systems and services must be consistent with the current GSO environment. For example, the flexibility of a BSS operator to raise or lower power levels is already considerably constrained by the presence of neighboring GSO satellites. There is no evidence that any future service that would be compatible with the current GSO regime would be hindered in any way by NGSO FSS systems.

134/ NPRM, ¶ 58.

3. GSO TT&C

The Commission also requests comment on how GSO BSS TT&C operations will be protected.[135/] As the Commission noted, the issues are no different than for GSO FSS, and SkyBridge proposes that the Commission follow the proposal outlined for GSO FSS in Section IV.E.3 above for BSS as well.

135/ NPRM, ¶ 62.

V. NGSO FSS SHARING WITH FS

A. Gateway Operation

SkyBridge proposed in its Petition that NGSO FSS use of certain bands heavily used by FS operators be limited to "gateway" operations,[136/] and therefore supports the Commission's proposal to limit NGSO FSS use of certain Ku-bands to gateway operations only. Deployment of ubiquitous NGSO FSS user terminals in these bands could substantially impede sharing with FS operations.[137/] SkyBridge gateways, on the other hand, are quite limited in number, and therefore may be coordinated with FS links without burdening FS expansion.[138/] This was demonstrated in SkyBridge's 1997 Amendment, by means of calculations demonstrating that the separation distance between FS stations and SkyBridge gateways will be relatively small.

More recently, SkyBridge commissioned Comsearch to perform an independent analysis of the separation distances computed by SkyBridge. The results of this study, attached as Appendix C, are in close correlation with the SkyBridge computations. SkyBridge also commissioned a study, attached as Appendix D,

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136/ SkyBridge Petition at 11, 17.

137/ Some of the Ku-band NGSO FSS systems filed at the January 8, 1999 cut-off appear to propose use of non-gateway, ubiquitous earth stations in the 10.7-11.7 GHz, 12.75-13.25 GHz, 13.75-14.0 GHz and 17.7-17.8 GHz bands. SkyBridge agrees with the Commission's determination that this could be severely detrimental to FS use of the bands.

138/ It appears that the gateways (as defined by the Commission, see Section V.A.1 below) of other Ku-band NGSO FSS systems filed at the January 8, 1999 cut-off are also limited in number.

showing the efficacy of employing shielding as a means for reducing separation distances.

As demonstrated in Appendix C, the required separation distances[139/] between NGSO FSS gateways and FS stations are expected to be on the order of a few tens of kilometers, or even a few kilometers, depending on the pointing direction of the FS antenna (i.e., the off-axis angle between the pointing direction of the FS antenna and the direction of the NGSO FSS earth station), the terrain characteristics (including shielding) of the path between the FS stations and the NGSO FSS earth station, and the characteristics of both the FS and the NGSO FSS systems.

These studies confirm the ability of gateways of appropriately-designed NGSO FSS systems to share with FS systems. As described below, with an appropriate definition for "gateway" operations, and a coordination procedure that contemplates use of shielding as necessary, the two services will be able to amicably share without undue constraints on either service, and without the imposition of burdensome geographic or technical exclusions on NGSO FSS operations.

139/ The *coordination distance* (see 47 C.F.R. § 25.201) defines the distance, along a given azimuth from an earth station, within which there is a possibility of harmful interference to or from a terrestrial station. By definition, the minimum coordination distance is 100 km. By contrast, SkyBridge uses the term *separation distance* to define, in the context of a detailed interference analysis, the actual distance between a given terrestrial station and an earth station that is required to ensure a given I/N at the receiver under consideration.

1. Gateway Definition

The Commission proposes to define gateways as follows: "Gateway earth station complexes are not intended to originate or terminate traffic but are primarily intended for interconnecting to other networks."[140/]

SkyBridge is concerned that the definition does not sufficiently limit permissible gateway operations to the extent necessary to limit their numbers. To ensure that a user earth station that acts as an intermediary between the NGSO satellites and a group of users connected terrestrially to the user earth station (i.e., a "master" antenna) does not qualify as a "gateway," SkyBridge proposes that the Commission modify its proposed definition to clarify that gateways are not intended to handle traffic at user sites. Furthermore, SkyBridge is concerned that the concept of termination of traffic may not be sufficiently precise. A gateway may be seen from a terrestrial network as a network termination (e.g., Internet proxy).

Therefore, SkyBridge proposes the following definition for "gateway earth station complexes":

> Gateway earth station complexes provide satellite radio frequency resources to NGSO FSS network user earth stations within each gateway coverage area, and thereby interconnect the user earth stations with other networks.

The Commission also proposed to permit "only one gateway earth station complex within each NGSO spacecraft antenna beam."[141/] SkyBridge opposes this rule, because it overly constrains NGSO FSS system design. Most importantly, it presupposes that all the NGSO FSS systems use so-called "sticky beams," which is

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[140/] NPRM at 56 (proposed new definition in Section 25.201).

[141/] NPRM at 57 (proposed Section 25.203(k)).

not the case. Furthermore, there may be instances in which two or more gateway facilities are required, for example where a cell served by a single beam overlaps two or more countries.[142/] Finally, such a rule provides no demonstrable benefit to FS operators, in view of the tighter gateway definition proposed above.

Finally, the Commission has proposed that, while each gateway earth station complex may include multiple antennas, each complex must be located within a one second latitude and longitude square.[143/] This size limit is overly restrictive, because one second of longitude or latitude is about 30 meters or less. In order for SkyBridge gateway earth station antennas within a gateway complex to avoid blocking one another, they must be separated by 20 to 45 meters, depending on antenna size. A gateway complex will have multiple gateway antennas (generally 2-6 in the case of SkyBridge). Therefore, SkyBridge urges the Commission to refrain from imposing a limitation on gateway complex size; obvious cost considerations (land, fencing, possible shielding) can be relied upon to ensure that gateway operators do not build larger facilities than necessary.

142/ In such case, the gateways would share the available spectrum resource.

143/ NRPM at 56 (proposed new definition in Section 25.201).

2. Coordination of NGSO FSS Gateways and FS Stations

a. Coordination Procedures

The Commission has proposed that the NGSO FSS gateways and FS links coordinate, as necessary, according to the existing FS/FSS coordination procedures in the Commission rules.[144/] SkyBridge supports the Commission's proposal to use existing coordination procedures to facilitate sharing among NGSO FSS gateways and FS links.

The Commission further proposes to apply to NGSO FSS systems the method for calculating coordination areas specified in the Commission rules for GSO FSS systems.[145/] This would, in effect, base the technical aspects of the coordination on Appendix 28 of the ITU Radio Regulations, in its present form. As noted by the Commission, however, the ITU-R Recommendations for calculation of coordination areas generally lead to smaller coordination areas for NGSO systems than for GSO systems. This is due to the time-varying nature of the horizon gain of the NGSO FSS antenna. A great deal of work is currently underway in the ITU-R study groups[146/] on this topic, with a view toward appropriately revising Appendix 28/S7.

SkyBridge urges the Commission to take advantage of the work in progress at the ITU. Use of the smallest appropriate coordination distance will reduce the coordination burden to both FS and NGSO FSS operators. Furthermore,

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144/ NPRM, ¶ 22. The current Commission coordination procedures are contained in 47 C.F.R. § 25.251.

145/ NPRM, ¶ 22.

146/ Task Group 1/6.

use of the most current ITU coordination procedures is consistent with Commission policy. The Commission has, in fact, removed rules detailing these procedures because they are amended so frequently and become outdated so quickly, opting instead to simply reference ITU Appendix 28 in Section 25.251.[147/] Therefore, SkyBridge proposes that the Commission base the technical aspects of the coordination on Appendix 28/Appendix S7 of the ITU Radio Regulations, as revised by WRC-2000, for NGSO (and GSO) systems.[148/]

b. Gateway Site Shielding

As shown in Appendix C, shielding around a gateway complex can be an important determinant of the actual separation distance required between an FS station and an NGSO FSS gateway. Furthermore, the study contained in Appendix D demonstrates that, in the general case, up to 20 dB of artificial[149/] shielding can be constructed at reasonable cost, generally without any material adverse impact on the gateway's technical performance.[150/] SkyBridge therefore proposes, in an effort to

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147/ Streamlining the Commission's Rules and Regulations for Satellite Application and Licensing Procedures, Report and Order, IB Docket No. 95-117, rel. Dec. 16, 1996, ¶¶ 52-53.

148/ This assumes that there will be no application for an NGSO FSS earth station prior to WRC-2000. In the event that there is, Recommendations 847 and 849 should apply.

149/ The study was conducted assuming no (0 dB) natural shielding.

150/ In any given case, the ability to actually construct 20 dB of shielding may be impeded by the local terrain or surrounding buildings. Furthermore, once initial shielding is put in place to reduce emissions along a given path, later shielding to protect in other directions may cause internal reflections, decreasing the effectiveness of the pre-existing shielding. Thus, the nature, amount and location of shielding that can effectively be employed around a (continued...)

avoid unnecessary restrictions on FS growth, that NGSO FSS operators assume an obligation, incorporated in the Commission's rules,[151] to accept shielding of gateway complexes, as follows:

> (1) If a FS operator proposes to install a new FS link that would otherwise be precluded by an existing NGSO FSS gateway, and the installation of shielding at the gateway would eliminate the preclusion, the FS operator may require the NGSO FSS gateway operator to accept shielding at its gateway site, to the extent necessary to permit the introduction of the FS link, and to the extent possible given the surrounding terrain and buildings and the need to preserve the effectiveness of pre-existing shielding, so long as the shielding does not degrade the performance of the NGSO FSS gateway. In such case, the FS operator shall pay for the costs of the shielding.
>
> (2) In installing a gateway, an NGSO FSS operator shall not be required to install shielding to protect future FS links. The operator could, of course, employ shielding around its gateway complex in order to achieve successful coordination with one or more existing FS links. In such case, the gateway operator would incur the costs of the shielding.
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> (3) In coordinating new FS links with existing NGSO FSS gateways for which shielding has been implemented, the existing shielding should be taken into account by the new FS link for the detailed interference analysis that follows the coordination request.

3. Gateway Siting Restrictions

In the 10.7-11.7 GHz band, the Commission has proposed to exclude gateways within a radius of 100 km around the city center of the 50 most populated cities in the United States, as defined by the 1990 Census, subject to a sunset date to be determined.[152] The purpose of the exclusion zones is to allow the FS industry a

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150/ (...continued)
given gateway can only be determined on a case-by-case basis, focusing on, e.g., the direction and distance to a proposed FS facility and its precise technical parameters.

151/ For example, in 47 C.F.R. § 25.203(c).

152/ NPRM at 57 (proposed Section 25.203 (k)) and ¶ 23.

"head start" in building out the 10.7-11.7 GHz band in urban areas before the entry of NGSO FSS gateways in those regions. The Commission has not proposed such restrictions in the 12.75-13.25 GHz band, because the band is already built-out and has not been targeted for relocating services.[153/]

In view of the limited numbers of gateways and small separation distances resulting from application of the rules proposed above, SkyBridge believes restrictions on gateway siting are unnecessary to the FS industry and burdensome to NGSO FSS operators.

First, a comparison of current FS build-out patterns and the 100-km regions proposed by the Commission shows that the exclusion zones do not necessarily correspond to the areas of greatest FS deployment. In fact, FS deployment depends on a variety of factors besides population density, including terrain, transportation and pipeline rights of way, and installation of industrial and commercial facilities. As a result, not all urban areas are equal in terms of FS use. For example, where fiber is easier to install (flat terrain), FS use is less important. On the other hand, in mountainous regions where fiber is hard to install, the market for FS links is greater.

Second, although it is unlikely that gateways would be installed in urban or suburban areas due to real estate costs and, in some cases, the need to protect existing FS links, it is important that gateways be located near the terrestrial

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153/ However, while the text of the NPRM, at ¶¶ 23 and 34, proposes geographic siting restrictions only in the 10.7-11.7 GHz band, the proposed Section 25.203(k) applies such restrictions to the 12.75-13.25 GHz and 13.8-14.0 GHz bands as well.

infrastructure, such as optical fiber links, needed to connect the gateways to terrestrial networks. NGSO FSS operators must have the flexibility to choose optimum sites for gateways, which, in some cases, may fall within the 100-km exclusion zones proposed by the Commission. Furthermore, as noted above, it is far from clear that establishing a gateway will impede FS expansion in a given case.

Finally, the Commission's proposed rule would impose a burden on NGSO FSS operators that the Commission explicitly stated in the NPRM would be inappropriate. As noted above, the Commission determined that geographic restrictions on NGSO FSS gateway operation was not necessary in any of the subject NGSO FSS uplink bands. However, any such restriction in the 10.7-11.7 GHz band will necessarily impose the same restriction on the uplink bands, such as the 12.75-13.25 GHz band, because gateway facilities will always operate both uplinks and downlinks.

For these reasons the Commission's proposed rule does not accomplish its objectives. It fails to accurately define those geographical regions that could benefit from an FS "head-start" (assuming arguendo that one was necessary in any event), and in the process unnecessarily and significantly constrains NGSO FSS operators in selecting the most appropriate gateway sites. While mindful of the need to allow FS expansion in the 10.7-11.7 GHz bands, SkyBridge believes that this concern would be fully addressed by rules, as proposed above, governing gateway definition and coordination.

4. Restrictions on Gateway Antenna Size or Number

The Commission has also requested comment on whether a minimum gateway antenna size, or a limit on the number of gateways per NGSO FSS system, should be adopted to facilitate sharing with FS.[154/] For the reasons already described above, SkyBridge believes such restrictions would be neither necessary nor wise. Such restrictions may impede the development of new technologies and result in economic inefficiencies. Furthermore, they would be of dubious benefit to FS operators, in view of the protection afforded to FS build-out by the gateway definition and coordination procedures proposed above, which already act to strictly limit the number of NGSO FSS gateways.

5. OpTel Petition

The Commission requested comment on how greatly expanded FS deployment could affect sharing with NGSO FSS gateways.[155/] The Commission pointed specifically to the Petition for Rulemaking filed by OpTel, Inc. requesting amendment of the Commission's rules to allow licensees in the Private Operational Fixed Point-to-Point Microwave Service ("OFS") to use frequencies in the 12.7-13.25 GHz band for the delivery of video programming material ("OpTel Petition").[156/]

The 12.7-13.25 GHz band is currently available to licensees in the Cable Antenna Relay Service ("CARS"). OpTel proposes to expand the class of point-to-point users of the band to include OFS, for use for the "final RF link in the

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154/ NPRM, ¶ 15.

155/ NPRM, ¶ 35.

156/ See Public Notice, Report No. 2267-CORRECTED (Apr. 16, 1998).

chain of transmission of program material to cable television systems, multipoint distribution systems, or master antenna TV systems."[157] As the SkyBridge System has been designed to protect such point-to-point systems in the subject band, and to allow for expansion of such networks, SkyBridge has not opposed the specific changes proposed in the OpTel Petition. So long as such links are subject to the coordination procedures proposed above, such use should not significantly inhibit sharing between the FS and NGSO FSS services.

SkyBridge would, however, caution the Commission against expanding the terrestrial users of this band to include dissimilar operations, such as point-to-multipoint systems, or use of wide-beam antennas, or to introduce different licensing regimes, such as area-wide licensing. Such changes would significantly alter the sharing environment in the band, adversely affecting both satellite and current FS users alike.[158]

B. NGSO Satellite PFD Limits

The JTG 4-9-11 and other ITU-R study groups,[159] with U.S. FS industry participation, have spent considerable effort assessing the satellite PFD limits

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157 OpTel Petition at 1.

158 Sufficient allocations for such uses already exist in the 2.5 GHz, 24 GHz, and 28 GHz bands, for the Multichannel Multipoint Distribution Service ("MMDS"), the Digital Electronic Message Service ("DEMS"), and the Local Multipoint Distribution Service ("LMDS"), respectively. See 47 C.F.R. § 21.901; §§ 101.147(r), 101.505; and § 101.1005.

159 E.g., Correspondence Group of WP 9A.

necessary to protect FS stations from NGSO FSS downlink emissions. These studies have taken into account the following factors:

- the characteristics of the FS systems to be protected, including use of Automatic Transmitter Power Control ("ATPC") by such links;[160/]
- the appropriate FS protection criteria (including both short and long term protection requirements);
- the appropriate methodology to assess the adequacy of the PFD limits to meet the FS protection requirements; and
- the impact of the aggregation of interference from multiple NGSO FSS constellations.

The JTG has recently reached conclusions on all of these issues, and has confirmed that the current Article S21 per-satellite PFD limits are adequate for the protection of the FS in the 10.7-12.75 GHz bands,[161/] considering both the long term and short term protection requirements of such systems.[162/] SkyBridge fully

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160/ The JTG considered several cases, including links with 37 dB and 47 dB fade margins, and an ATPC range of 13 dB, and thereby took into account worst-case link design.

161/ The analysis assumed three non-homogeneous NGSO FSS systems contributed to the aggregate interference to FS systems. The JTG agreed, however, that the results would remain valid if the number of NGSO FSS systems were in the range of 3 to 5. See Document 4-9-11/TEMP/72(Rev.1) (Long Beach). See also, Document RCG 9A-Interference/3(Rev.1) (Long Beach); Document 4/9/11/236 and Addendum 1.

162/ The Commission requested comment on the need for short term limits for protection of FS systems from NGSO FSS downlinks. NPRM, ¶ 20. The JTG agreed on a short term protection criteria for FS systems (maximum I/N of +20 dB never to be exceeded), and determined that the PFD limits will achieve this criteria. Therefore, FS will be protected in both the short term and long term.

The Commission also requested comment on whether FS links that operate over mountains, and hence may point above the horizon, will be protected from main beam to main beam interference. NPRM, ¶ 20. Data provided to SkyBridge by Comsearch analyzed the antenna elevation angles of FS antennas in the 10.7-11.7 GHz band. The median elevation angle was found to be

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supports the results of the JTG studies, and therefore supports the Commission's proposed revision to 47 C.F.R. § 25.208(b), incorporating the Article S21 limits in the 10.7-11.7 GHz band.[163] Although not proposed by the Commission, SkyBridge would also support inclusion of the Article S21 limits in the 11.7-12.7 GHz band in § 25.208.[164]

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[162] (...continued)
about -0.08 degrees. Ninety percent of receive antennas were found to have an elevation angle lower than 2.03 degrees. Ninety five percent were found to have an elevation angle lower than 3.75 degrees. All the calculations of NGSO FSS interference into FS receivers have been made using the PFD mask, which is constant for elevation angles from 0° to 5°. Using this methodology, even for receive antennas pointing at 5° elevation, the maximum (short-term) interference will be just 2.4 dB higher than the one for antennas pointing at 0° elevation (these 2.4 dB correspond to the difference in atmospheric losses at 0° and 5° elevation). The maximum short-term interference caused by an NGSO satellite that meets the -150/-140 PFD mask would be less than 11 dB for a 45 dBi antenna and less than 15 dB for a 49 dBi antenna. Therefore, the maximum short term interference level for a FS receive antenna pointing as high as 5° elevation remains within the short term protection criteria for FS links described above. This result also has to be considered in conjunction with the probability of occurrence of such an event; in reality, there is a very low probability that an FS receiver will see in its main beam a satellite that is generating the maximum PFD limit in that direction (a PFD mask is an envelope over azimuth of the maximum PFD values generated by one satellite).

[163] In 10.7-11.7 GHz, Article S21 prescribes the following PFD limits:

-150 dB(W/m^2/4kHz) for $0° \le \delta < 5°$
$-150 + (\delta - 5)/2$ dB(W/m^2/4kHz) for $5° \le \delta < 25°$
-140 dB(W/m^2/4kHz) for $25° \le \delta < 90°$

where δ is the angle of arrival above the horizontal plane.

[164] In 11.7-12.7 GHz, Article S21 prescribes the following PFD limits:

-148 dB(W/m^2/4kHz) for $0° \le \delta < 5°$
$-148 + (\delta - 5)/2$ dB(W/m^2/4kHz) for $5° \le \delta < 25°$
-138 dB(W/m^2/4kHz) for $25° \le \delta < 90°$

where δ is the angle of arrival above the horizontal plane.

will help control the interference environment. However, other rules will be required in order to ensure that multiple NGSO FSS systems can be deployed at Ku-band.

1. Satellite Diversity

First, it is necessary that all NGSO FSS systems be capable of employing satellite diversity to avoid in-line events with other NGSO FSS systems. Fortunately, most LEO and MEO systems inherently have this capability, at least to some extent, in order to mitigate interference to GSO systems.

However, not all NGSO constellations are able to employ satellite diversity to share with other NGSO systems. Classic QGSO systems, for example, operate from only a small portion of their orbit, in order to simulate the characteristics of a GSO system. Although multiple satellites are used to effect this simulation, traffic cannot be handed over to satellites that are not in the QGSO's "slot." Therefore, such systems generally appear to be incapable of mitigating interference from/to other NGSO systems.

Because the use of satellite diversity by all NGSO FSS entrants will be necessary to permit entry of multiple NGSO FSS systems in an equitable manner, the Commission should require all applicants to have this capability. Those that do not have sufficient ability to employ satellite diversity should not be licensed in these bands.[169/]

169/ The Commission has in the past limited access to satellite spectrum according to the flexibility of the technology and system design proposed. See Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to a Mobile Satellite Service in the 1610-1626.5/2483.5-2500 MHz Frequency Bands, 9 FCC Rcd 5936, 5946 (1994) (Big LEO Proceeding) ("LEO systems have greater potential [than GSO systems] to serve more

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VI. NGSO FSS / NGSO FSS SHARING

As is discussed in Section I above, a critical goal of this proceeding must be to ensure competition in the provision of high-speed, interactive broadband services throughout the U.S. and the world; Section 706 of the '96 Act and WRC-97 command nothing less. As the Commission concluded in its Section 706 Report -- and as supported by the world community's actions at WRC-97 -- access to these services for persons living outside of major metropolitan areas most likely will be provided exclusively by LEO satellite systems.[165/]

Thus, SkyBridge is in full agreement with the Commission's view that, to the extent technically feasible, multiple NGSO FSS systems should be accommodated at Ku-band.[166/] SkyBridge believes that this band can, in fact, accommodate multiple entry, so long as all such systems are designed in such a way that they can mitigate interference to/from other NGSO systems.[167/] Such a capability becomes all the more important in the context of the International Radio Regulations, where S9.11a and S9.12 govern NGSO/NGSO sharing.

A. Sharing Techniques

The Commission requested comment on what technical rules would facilitate sharing among NGSO FSS systems.[168/] As the Commission notes, its proposed NGSO earth station antenna performance requirements (see Section VII.C),

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165/ See, e.g., Section 706 Report at 28, nn.110-111.

166/ NPRM, ¶ 67.

167/ NPRM, ¶ 70.

168/ NPRM, ¶ 69.

2. Band Segmentation

The Commission requested comment on whether band segmentation is a feasible alternative if spectrum sharing proves unacceptable to any particular NGSO FSS system.[170/] In fact, as noted above, not all constellation designs are equally suited for sharing with all other constellations, and should not be forced to share the same bands.

However, as discussed above,[171/] provision of the sorts of broadband services intended by WRC-97 and Section 706 requires all of the spectrum that is the subject of this proceeding. Therefore, band segmentation is not a viable option. Rather the Commission should strictly enforce the proposed licensee qualifications discussed below to ensure that only serious applicants proposing systems providing global, broadband, interactive services are permitted to share this finite resource.

B. NGSO FSS Licensee Qualifications

In order to maximize the use of these bands, it will be necessary to impose basic technical and service requirements on systems to ensure that each system furthers the fundamental international and domestic objective of ensuring universal access to competing broadband NGSO FSS systems that offer high-speed interactive

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169/ (...continued)
uniformly the United States and international locations with smaller, more ubiquitous and lower power equipment. This leads us to conclude that the primary use of the subject spectrum should be by LEO systems.").

170/ NPRM, ¶ 69.

171/ See Section II above, and note 14.

services on a global basis. In order to achieve this goal, SkyBridge proposes the following basic qualifications for holding a Ku-band NGSO FSS license.

1. Ability to Mitigate Interference to other NGSO FSS Systems

As discussed above, NGSO FSS systems should be able to mitigate interference with other NGSO FSS systems. Otherwise, the number of systems that ultimately can be licensed may be substantially reduced, as well as the capacity of those systems. In SkyBridge's view, NGSO-NGSO sharing is best (perhaps only) accomplished through operational techniques which utilize the system's satellite diversity. This capability must be viewed as an essential qualification to be met by all Ku-band NGSO FSS applicants.

2. Ensuring Service Goals

As discussed above, the driving force behind WRC-97's embrace of NGSO FSS operations at Ku-band was the promise of global competition in the provision of interactive broadband services to individual consumers. The NPRM recognizes this fact, at least in part, by its proposed requirement that Ku-band NGSO FSS systems provide global service, and SkyBridge fully supports this requirement.[172/] However, the Commission must go further to ensure that these systems actually achieve the vision expressed both at WRC-97 and in Section 706 of the '96 Act. As a fundamental qualification to receive a license for a Ku-band NGSO FSS license, an applicant must be able to demonstrate that its system will be capable of providing full two-way connectivity adequate to support direct consumer access to the entire range of interactive broadband services.

[172/] NPRM, ¶ 84; see also Section VIII.A below.

Thus, applicants for authority to operate an NGSO FSS system at Ku-band should be required to demonstrate, as basic qualifying criteria, that their proposed system will: (1) provide global coverage; (2) offer a full range of high-speed broadband services; (3) provide full two-way interactive capability; and (4) offer direct access to the system for residential and business customers via low-cost ground terminals.[173/] Without these four requirements, the competitive marketplace for the provision of these services to individual consumers envisioned by the '96 Act and WRC-97 may not be realized.

3. Proposed Financial and Technical Qualifications

In addition to the qualifying considerations discussed above, SkyBridge urges the Commission to adopt the financial qualifications standards and various technical standards proposed in the NPRM,[174/] and apply them in the strictest fashion. This too will help to expedite licensing of those applicants that are actually ready, willing and able to proceed to deliver service.

C. U.S. Processing Round

1. First Round

As is inevitably the case in dealing with a scarce resource, more entities will seek to use it than can effectively be accommodated. While it seems

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173/ In order to ensure that this technology is truly able to benefit all Americans, especially those living in rural and remote areas, the Commission should require that the user terminal links to and from NGSO FSS gateways be made using the NGSO FSS radio resources, and not rely on terrestrial paths for either of these links. In this way, the Commission can ensure that these new, truly interactive services are available regardless of accessibility to or adequacy of terrestrial facilities.

174/ See NPRM, ¶ 85 and Section VIII.B below.

clear that multiple NGSO FSS systems can co-exist at Ku-band (assuming certain technical parameters), it remains equally clear that, even under optimistic scenarios, the number of such systems is small.

As discussed in Section III.A.3, studies to date indicate that significant constraints and capacity penalties are imposed in order to accommodate only a small number, e.g., three, NGSO FSS systems. The U.S. processing round must be conducted in such a way that this reality does not stall the licensing process, delaying commencement of the important services to be provided by the Ku-band NGSO FSS systems.

As noted above, certain basic qualifications must be met by each applicant. If, after application of such rules, the Commission has before it more qualified applicants than can be accommodated, it has at hand the basic statutory tools set out in Section 309 of the Communications Act.[175/] However, prior to using any of those tools, the Commission should require the applicants to attempt to negotiate a solution that enables all parties to be licensed.[176/]

It must be understood that the level of analysis required to successfully negotiate a sharing protocol among NGSO systems is extraordinarily complicated. Negotiations will not succeed unless all parties are serious and are at an advanced stage in their system design. This is because the evaluation of NGSO-NGSO sharing is extremely complex. The analysis of the ability of the multiple constellations to

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175/ 47 U.S.C. § 309.

176/ In Section X infra, SkyBridge sets out a schedule for the initiation of this negotiation process, which should begin even before final determinations are made with respect to the qualifications of various applicants.

share is complicated by the extensive variation in the systems. The orbits, altitudes, number of beams, spacecraft design, antenna types, beam types (fixed, tracking or pointing) and GSO protection schemes are just some of the characteristics unique to each system that must be taken into account in analyzing sharing. Building accurate computer models to analyze the ability of multiple unique systems to share also is very complex and time-consuming. Further, as has been recognized in the ITU-R process, because of the time-varying nature of NGSO FSS interference, obtaining accurate results requires a large amount of computer time and resources.

As the Commission is aware, a critical balance exists in the design of these systems, to ensure that each is capable of meeting its own performance goals. Thus, as part of the above-described negotiating process, no party should be forced to alter its system design involuntarily.

Furthermore, time is of the essence for deployment of services. The Commission must ensure that any negotiations are governed by ground rules that prevent parties from stalling the process for anticompetitive or other reasons. Success will only be achieved if applicants are fully committed to the process.

2. Later Rounds

Later processing rounds will only be possible if certain criteria are met. Most importantly, the licensed systems must be operating -- and be able to continue to operate -- to the level of the single entry limits. That is, later entrants should not be permitted if the initial entrants have not been able to employ the full resources afforded by the single entry limits.

If a later round becomes possible, the NPRM asks whether, as part of a burden-sharing requirement, earlier systems (e.g., first round systems) should be forced to alter their existing design or operations to accommodate later systems.[177/] The answer to this question is an emphatic no.

It is not technically or financially reasonable, or consistent with longstanding Commission policy, to ask a previously-licensed system, particularly one in operation, to materially alter its parameters to accommodate a later entrant. Once launched, the operator's ability to include additional mitigation resources is severely constrained. The only option most likely available would be to reduce power, which has a substantial adverse impact on system capacity, and hence the economic viability of the system. Such a requirement would be unprecedented in Commission's regulation of satellite systems, and flatly contrary to the public interest. Just as it is critical that the substantial investment in existing GSO systems not be jeopardized by having to make material operational changes to accommodate new NGSO systems, so too must NGSO operators be free from the same sort of threat from later NGSO systems.

177/ NPRM, ¶ 70.

VII. NGSO FSS SERVICE RULES

A. Mitigation Techniques to Protect GSO Arc

SkyBridge agrees with the Commission's proposal not to place in the Commission's rules any requirement on the interference mitigation techniques employed by an NGSO FSS system to protect the GSO arc.[178/] A variety of techniques may be used by such systems, depending on the services to be provided and the constellation architecture. The sole requirement with respect to GSO protection should be compliance with the EPFD and $EPFD_{up}$ limits, which take into account all of the protection requirements of GSO systems.

B. Off-Axis EIRPs

WRC-97 included off-axis EIRP limits, applicable to all Ku-band FSS systems (both GSO and NGSO), in Article S22. These limits were suspended, pending review, and various ITU-R study groups have been assessing the appropriateness of the suspended limits.

JTG 4-9-11 recently tentatively proposed off-axis EIRP limits for the 12.75-13.25 GHz and 13.75-14.5 GHz bands[179/] that relax the suspended S22 limits by 3 dB in all directions. The motivation was to take into account the fact that some GSO antennas have less discrimination in directions other than along the GSO arc, while at the same time maintaining a requirement that is symmetrical, and not dependent on direction in relation to the GSO arc.

178/ NPRM, ¶ 75. However, as noted supra, satellite diversity capability should be made a NGSO FSS qualifying factor due to the necessity of NGSO-NGSO coordination.

179/ See Document 4-9-11/TEMP/47(Rev.2) (Long Beach).

Notwithstanding these tentative agreements, the work on these limits is ongoing. The ultimate limits should take into consideration the actual protection requirements of GSO and NGSO systems, an aspect of the problem that has not been considered in these studies to date. With respect to NGSO systems, the work within the JTG has just commenced.[180/] While SkyBridge proposes that the Commission adopt off-axis EIRP limits, as it has proposed in Section 25.204(g),[181/] SkyBridge urges the Commission to adopt limits reflecting the ultimate outcome of the ITU-R studies.

Several related decisions were taken at JTG that the Commission should reflect in its rules. First, it was agreed that the off-axis EIRP density of telecommand and ranging carriers transmitted to GSO satellites in normal mode of operation[182/] may exceed the Article S22 levels by no more than *X* dB, with *X* to be determined through further study. In all other modes of operation, telecommand and ranging carriers transmitted to GSO satellites are exempted from the limits.[183/] Studies are underway to determine whether a similar rule should be applied to NGSO systems.

Furthermore, in cases of *force majeure* it was decided that telecommand and ranging carriers transmitted to NGSO FSS satellites are not subject

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180/ See Documents 4-9-11/259 and 314.

181/ NPRM at 57-58.

182/ I.e., earth station transmitting telecommand and ranging carriers to a directive receiving antenna on the space station.

183/ See Document 4-9-11/TEMP/42(Rev.1) (Long Beach).

to the off-axis EIRP limits. Further studies are required to determine whether exemptions from these limits are needed in cases other than *force majeure*.

SkyBridge therefore proposes to modify proposed Section 25.204(g) as follows, with the values of X, Y, and Z to reflect the output of the ITU-R working groups:

> The level of equivalent isotropically radiate power (e.i.r.p) emitted by an earth station transmitting to GSO FSS or NGSO FSS satellites in the frequency bands 12.75-13.25 GHz, 13.75-14.5 GHz, and 17.3-17.8 GHz, except for telecommand and ranging functions, shall not exceed the following values for any off-axis angle, θ, which is 2.5 degrees or more off the main lobe axis of an earth station antenna:
>
> | Off-axis angle | Maximum e.i.r.p. density (dBW/40kHz) |
> |---|---|
> | $2.5° \le \theta \le 7°$ | 39-25 log θ + [Z] |
> | $7° < \theta \le 9.2°$ | 18 + [Z] |
> | $9.2° < \theta \le 48°$ | 42-25 log θ + [Z] |
> | $48° < \theta \le 180°$ | 0 + [Z] |
>
> For FM-TV emissions with energy dispersal, the above limits may be exceeded by up to 3 dB provided that the off-axis e.i.r.p. of the transmitted FM-TV carrier does not exceed the following values:
>
> | Off-axis angle | Maximum e.i.r.p. (dBW) |
> |---|---|
> | $2.5° \le \theta \le 7°$ | 53-25 log θ+ [Z] |
> | $7° < \theta \le 9.2°$ | 32 + [Z] |
> | $9.2° < \theta \le 48°$ | 56-25 log θ + [Z] |
> | $48° < \theta \le 180°$ | 14 + [Z] |
>
> FM-TV carriers which operate without energy dispersal should be modulated at all time with program material of appropriate test pattern. In this case, the off-axis total e.i.r.p. of the emitted FM-TV carrier shall not exceed the following values:
>
> | Off-axis angle | Maximum e.i.r.p. (dBW) |
> |---|---|
> | $2.5° \le \theta \le 7°$ | 53-25 log θ + [Z] |
> | $7° < \theta \le 9.2°$ | 32 + [Z] |
> | $9.2° < \theta \le 48°$ | 56-25 log θ + [Z] |
> | $48° < \theta \le 180°$ | 14 + [Z] |
>
> The off-axis e.i.r.p density of telecommand and ranging carriers transmitted to GSO FSS satellites in normal mode of operation (i.e., transmitted to a directive receiving antenna on the space station) may exceed the above levels by [X] dB. In all other modes of operation, such carriers are exempt from these limits.

The off-axis e.i.r.p density of telecommand and ranging carriers transmitted to NGSO FSS satellites in normal mode of operation (i.e., transmitted to a directive receiving antenna on the space station) may exceed the above levels by [Y] dB. In cases of force majeure, telecommand and ranging carriers transmitted to NGSO FSS satellites are exempted from these limits.

These limits do not apply to earth stations ready to be in service (i.e., installed, but service has been delayed due to force majeure) prior to [XXXX] nor to earth stations associated with satellites in the FSS for which complete coordination or notification information has been received before 2 June 2000.

C. NGSO FSS Earth Station Antenna Patterns

The Commission proposes to apply the 32-25 logθ antenna pattern, which currently governs GSO earth stations under Section 25.209, to NGSO FSS user earth stations.[184/] SkyBridge believes that this requirement would unnecessarily constrain NGSO FSS operations, in view of the more complex antenna equipment (steered, paired beams) needed for NGSO FSS systems, as compared to GSO systems.

While SkyBridge's larger "professional" class of user terminals are anticipated to meet the Commission's proposed standard, as SkyBridge explained in its 1997 Amendment, such a pattern is not feasible for its "residential" class of user terminals, which must conform to strict size and cost objectives.[185/] The Commission's proposed standard was not developed for antennas as small as those used for residential user terminals, which are even smaller than those used in the BSS. Therefore, SkyBridge has proposed a more relaxed 36-25 logθ pattern, specified below, for NGSO FSS user earth stations.

Assessment of how such user terminal antenna performance actually affects NGSO/GSO and NGSO/NGSO sharing requires a detailed analysis, due to the importance of the "lobe effect."[186/] Therefore, for such purposes, SkyBridge proposes that the same patterns used in the EPFD definition and by the software tool for GSO FSS and BSS antennas (see Section VII.D.3) should be used, for the antenna size

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184/ NPRM, ¶ 78.

185/ 1997 Amendment at 7.

186/ See Section VII.D.3.

corresponding to the NGSO FSS user terminals, and not the simple 36-25 logθ pattern proposed for the Commission's rules. SkyBridge is exploring this approach within the ITU-R study groups, and proposes that the Commission adopt any recommendations on this topic coming out of the international forum.

The Commission proposed to adopt the tighter 29-25 logθ antenna pattern to NGSO FSS gateway earth stations.[187] SkyBridge agrees with this proposal, which will facilitate sharing among NGSO FSS gateways and FS stations.

SkyBridge does not agree with the Commission's proposal that the peak gain of an individual sidelobe may not exceed the prescribed envelope. SkyBridge proposes instead the more usual requirement[188] that the envelope may be exceeded by no more than 10% of the sidelobes, provided no individual sidelobe exceeds the gain envelope by more than 6 dB.

With these considerations in mind, SkyBridge proposes that the Commission modify its proposed additions to Section 25.209 as follows:

> (h) Gateway earth station antennas operating in the frequency bands 10.7-12.7 GHz, 12.75-13.25 GHz, 13.75-14.5 GHz, and 17.3-17.8 GHz,[189] and communicating with NGSO FSS satellites, shall have the following antenna performance. Outside of the main beam, the gain of the antenna shall lie below the envelope defined by:
>
> | | |
> |---|---|
> | 29-25 $\log_{10}$ (θ) dBi | $1° \leq \theta < 36°$ |
> | - 10 dBi | $36° \leq \theta \leq 180°$ |
>
> where θ is the angle in degrees from the axis of the main lobe, and dBi refers to dB relative to an isotropic radiator. For the purposes of this section, the envelope may be exceeded by no more than 10% of the

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187/ NPRM, ¶ 79.

188/ See 47 C.F.R. § 25.209(a)(2).

189/ See SkyBridge proposals in Sections II.A-C above.

sidelobes provided no individual sidelobe exceeds the gain envelope given above by more than 6 dB.

(i) User earth station antennas operating in the frequency bands 11.7-12.2 GHz, 12.2-12.7 GHz, 14.0-14.5 GHz and communicating with NGSO FSS satellites shall have the following antenna performance. Outside of the main beam, the gain of the antenna shall lie below the envelope defined by:

$36\text{-}25 \log_{10} (\theta)$ dBi	$100 \lambda/D \leq \theta < 48°$
- 6 dBi	$48° \leq \theta \leq 180°$

where θ is the angle in degrees from the axis of the main lobe, and dBi refers to dB relative to an isotropic radiator. For the purposes of this section, the envelope may be exceeded by no more than 10% of the sidelobes provided no individual sidelobe exceeds the gain envelope given above by more than 6 dB.

D. Confirming Compliance with EPFD Limits

As noted in the NPRM,[190] the JTG 4-9-11 has developed a software tool to be used by the ITU Radiocommunication Bureau ("BR") to assess compliance of a proposed NGSO FSS system with the EPFD and $EPFD_{up}$ limits in the ITU Radio Regulations.[191] SkyBridge supports use of the same software tool by the Commission for purposes of assessing compliance with domestic rules and confirming the information that will be sent to the ITU.

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[190] NPRM, ¶ 80.

[191] The Commission states that the JTG 4-9-11 software is being developed to assess compliance with EPFD, $EPFD_{up}$, and PFD limits. NPRM, ¶ 80. In fact, the software is only intended to be used to compute EPFD and $EPFD_{up}$ levels. With respect to PFD limits, SkyBridge agrees with the Commission's proposal to require NGSO FSS applicants to provide a sufficient technical showing to demonstrate that the proposed system meets the PFD limits contained in Section 25.208, as applicable. NPRM at 54.

1. Description of Software Tool

The JTG tool has the following features, which ensure that an NGSO system that meets the EPFD and $EPFD_{up}$ limits according to the software will actually do so in practice, at all times and locations:

- The tool computes envelopes of the uplink and downlink emissions of a given NGSO FSS system, taking into account the specific mitigation techniques employed by the system to protect other services.
- The tool aggregates the emissions from all satellite beams that can be generated by an NGSO satellite, and all NGSO earth stations within the coverage of the GSO satellite.
- The tool does not rely on the particular resource management strategy used by the NGSO system, which, as discussed below, will change throughout the lifetime of the NGSO system. Rather, the tool assumes the worst-case resource configuration, eliminating the need for the regulator to re-assess the system each time the operator adjusts the resource allocation algorithm.
- The tool determines the maximum PFD generated by an NGSO FSS satellite, for the worst-case GSO earth station location and pointing direction, and the maximum PFD generated by NGSO FSS earth stations, for the worst-case GSO satellite location and pointing direction.
- The tool can be used for any kind of NGSO FSS system.
- The tool is relatively simple in concept and implementation.

For assessing the EPFD levels for an NGSO FSS system, the software tool uses "PFD masks" that are provided by the NGSO operator. These masks represent an envelope of the emissions from each NGSO satellite.[192/] (In the case of

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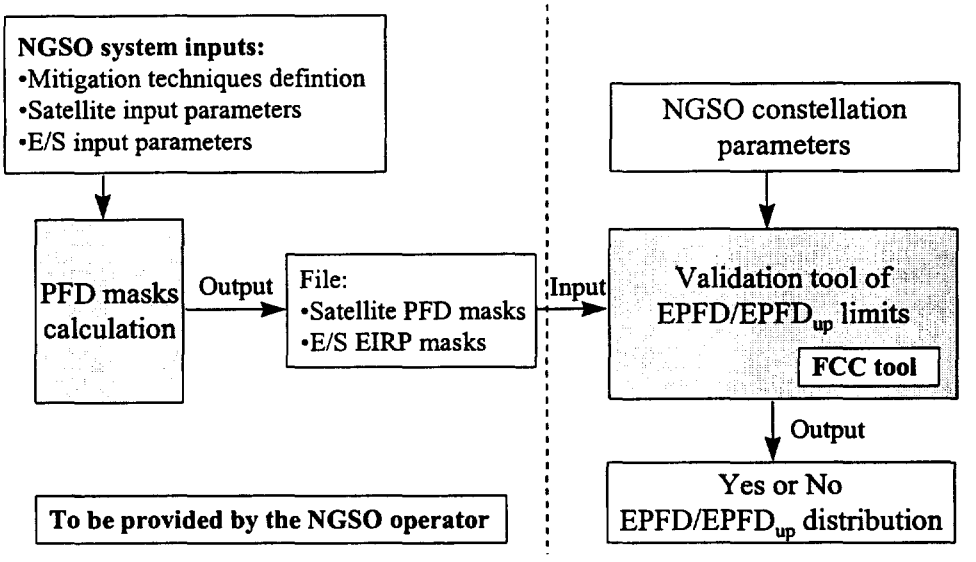
192/ Currently, two four-dimensional mask formats are being considered as possible inputs to the software tool (the choice of formats is up to the NGSO operator). The first format is defined as a function of: (1) the NGSO satellite; (2) the latitude of the NGSO sub-satellite point; (3) the separation angle between the NGSO satellite and the GSO arc, as seen from any point on the surface of the Earth; and (4) the difference in longitude between the NGSO sub-satellite point and the GSO satellite. The second format is defined as a function of: (1) the (continued...)

SkyBridge, the mask will be the same for all satellites.) For assessing the $EPFD_{up}$ levels, the software uses "EIRP masks" provided by the NGSO operator.[193] The tool itself computes the EPFD and $EPFD_{up}$ statistics, by applying the PFD masks to the satellites of the NGSO constellation and the EIRP masks to the NGSO earth stations. A block diagram of the approach is given below.



The PFD mask requires calculating, for each point on earth within the coverage area of an NGSO FSS satellite, the combination of generated beams that

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192/ (...continued)
NGSO satellite; (2) the latitude of the NGSO sub-satellite point; (3) the azimuth angle; and (4) the elevation angle. Document 4-9-11/TEMP/70 (Long Beach).

193/ The earth station EIRP mask is defined by the maximum EIRP as a function of the off-axis angle generated by an earth station. The density of NGSO earth stations per square kilometer, the EIRP mask, and the maximum number of NGSO space stations which can simultaneously serve a cell are used to compute $EPFD_{up}$. Document 4-9-11/TEMP/70 (Long Beach) and Document 4-9-11/TEMP/76 (Long Beach).

leads to the maximum PFD from the NGSO satellite. For a system like SkyBridge, for locations that see the NGSO satellite within 10° of the GSO arc, the PFD mask approach will provide the maximum levels of aggregate PFD that can be generated through the sidelobes of the NGSO satellite. To calculate the EPFD at the GSO earth station, the NGSO satellites that will create the highest PFD level at the GSO arc are selected. To compute $EPFD_{up}$, the NGSO earth station points toward those NGSO space stations just outside 10° of the GSO arc, to ensure that the maximum PFD at the GSO space station is computed.

2. NGSO FSS System Characteristics to be Provided

In order for the Commission to use the JTG 4-9-11 software tool, applicants should be required to provide the Commission with all the NGSO FSS system characteristics called for in the JTG software specification.[194/]

The Commission proposes to require applicants to provide NGSO "hand-over and satellite switching strategies."[195/] In fact, the JTG 4-9-11 software tool has been specifically designed to avoid the need to provide such information.

194/ See Document 4-9-11/TEMP/86 (Long Beach). The NGSO system parameters needed to calculate the satellite PFD mask are at least the following: NGSO satellite antenna gain for co- and cross-polarization; maximum satellite emitting power in the reference bandwidth; maximum number of co-frequency and co-polarization beams per satellite; and maximum number of co-frequency beams per satellite. The NGSO system parameters needed to calculate the earth station EIRP mask are at least the following: NGSO earth station antenna pattern; maximum earth station emitting power in the reference bandwidth; minimum elevation angle; maximum number of co-frequency tracked NGSO satellites; minimum angle to GSO arc; and density of NGSO earth stations. In addition, the NGSO orbit parameters are required to simulate the constellation to compute the EPFD and $EPFD_{up}$ distributions.

195/ NPRM, ¶ 81.

There are two very good reasons for this. First, such information corresponds directly to the capacity being provided to various markets, which is commercially-sensitive information. Second, such data changes frequently in response to changed demands for capacity. If this information were to be required by the software tool, compliance verification would need to be repeated often, which is not practical at either the ITU or Commission levels.

With these considerations in mind, the JTG 4-9-11 has developed software for computation of EPFD based on worst-case satellite PFD masks to be supplied by the NGSO FSS system operator.[196/] These masks are independent of traffic level and distribution and the hand-over and switching strategies employed by the operator, because they represent the maximum PFD that may be generated at any point on earth by the NGSO FSS space station using any possible beam configuration. This guarantees that, no matter what beam configuration is used at any given time, the power generated by the constellation toward a point on earth will be at or (more likely) below that considered in the simulations.

This simplification imposes no risk on GSO systems. In fact, it benefits GSO systems because it means that an NGSO system will have to demonstrate that it can meet the EPFD limits at any point on earth with its worst-case beam configuration for that point. In practice, systems will not operate all the satellites in the worst case beam configurations, and will generate lower powers

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196/ See Document 4-9-11/TEMP/70 (Long Beach).

overall than those contained in the PFD masks. This is why simulations using PFD masks predict greater interference than simulations using full system modeling.[197]

Furthermore, use of these PFD masks will not lead to a loss of transparency because the NGSO FSS system characteristics used to compute these worst-case masks will also be provided to the ITU BR by the NGSO FSS operator.[198] Therefore, with only the data to be supplied to the BR, the Commission will be able to fully assess the compliance of an NGSO FSS system with the EPFD and $EPFD_{up}$ limits.

Because providing hand-over and switching strategies is not practical, and because the technique used by the JTG to avoid the need for such information imposes no risk on, and actually further protects, other services, the Commission should not require applicants to provide this information. Rather, the Commission should require applicants to provide only those characteristics ultimately required to be provided to the BR in connection with the JTG 4-9-11 software tool.[199]

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[197] See Document 4-9-11/245, Document 4-9-11/345, and Document 4-9-11/TEMP/69 (Long Beach). In order to reduce the magnitude of the interference overestimate, the JTG has increased the number of parameters used in the PFD mask definition. Document 4-9-11/TEMP/49 (Long Beach). This will lead to a tighter bound on the PFD generated by a given satellite, without the need to consider hand-over and switching strategies.

[198] See Documents 4-9-11/TEMP/45 and 4-9-11/TEMP/86 (Long Beach).

[199] The Commission also proposes to require each NGSO FSS applicant to provide the orbital parameters contained in Section A.3 of Annex 1 to Resolution 46. Because the all of the orbital parameters necessary as input to the software tool are already specified in Section B of the software description, SkyBridge believes that this is unnecessary.

In view of the above considerations, SkyBridge urges the Commission to replace its proposed new rule 47 C.F.R. § 25.147(c)(3)[200/] with the following requirement:

> Each NGSO FSS applicant must submit the NGSO FSS system characteristics specified in Section B of the functional description of the ITU BR software contained in Recommendation ITU-R [TDB]. Further, each NGSO FSS applicant must provide a sufficient technical showing to demonstrate that the proposed NGSO FSS system meets the PFD limits contained in Section 25.208, as applicable.

3. GSO Reference Antenna Patterns

The GSO earth station antenna pattern is very important in the assessment of the interference from NGSO satellites into GSO earth station receivers. A great deal of study has been conducted in JTG 4-9-11, WP 4A, and JWP 10-11S on the appropriate GSO antenna patterns to be used in such analysis.[201/]

The JTG has recently agreed on a reference pattern for GSO FSS earth stations,[202/] for use in the calculation of the EPFD limits, to replace the reference pattern today defined in Article S22.[203/] For the GSO BSS earth stations, the JTG has

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200/ NPRM at 54.

201/ The diagrams currently defined in ITU recommendations and the Commission rules were developed for assessment of static GSO interference configurations, and take into account the envelope of all possible antenna patterns in order to ensure that link budgets consider the worst-case static interference. For NGSO FSS systems, it is important to take into account the fact that NGSO satellites sweep through the peaks and troughs of a GSO earth station antenna. More precise modeling of the receive antenna pattern than that provided by such envelope patterns permits more accurate interference calculations.

202/ The full specification of the antenna pattern is contained in Document 4-9-11/TEMP/71(Rev.1) (Long Beach).

203/ See Document 4-9-11/TEMP/71(Rev.1) (Long Beach). As discussed in Section VII.C above, SkyBridge also proposes that the same masks be used to (continued...)

agreed on patterns subject to confirmation by JWP 10-11S. For antennas with diameters of 60 cm or less, the JTG agreed that the software to be used by the BR should be capable of using 3-dimensional patterns for BSS earth stations. For 45 cm antenna patterns, the JTG provisionally recommended that the 3D pattern from Document 4-9-11/356 (Long Beach) be utilized.[204] The JTG also recommended patterns for antennas with diameters greater than 60 cm and a D/λ less than 100 and for antennas with a D/λ of 100 or greater.[205]

SkyBridge proposes that the Commission adopt the JTG antenna patterns for all compliance testing of Ku-band NGSO FSS systems.

E. Emissions

1. Emission and Frequency Tolerance Requirements

The Commission has requested comment on whether the existing emission and frequency tolerance requirements for FSS in Section 25.202 are sufficient to protect other incumbent Ku-band operations, particular in regard to ubiquitously deployed user terminals.[206] From the NGSO perspective, SkyBridge believes that Section 25.202 should be applied to both GSO FSS and NGSO FSS systems for the protection of other Ku-band operations.[207]

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[203] (...continued)
model NGSO FSS earth stations, for purposes of NGSO/NGSO sharing studies.

[204] Addendum 2 to Document 4-9-11/TEMP/65-E (Long Beach).

[205] Id.

[206] NPRM, ¶ 82.

[207] The SkyBridge System has very precise control over the frequency of its
(continued...)

2. Protecting Radio Astronomy

As the Commission noted in the NPRM, sensitive radio astronomy operations exist in the 10.6-10.7 GHz band, adjacent to the Commission's proposed NGSO FSS allocation, and footnote US 211 urges space stations in the 10.7-11.7 GHz band to take all practical steps to protect such operations.[208/] The Commission has requested comment on how NGSO FSS satellite downlink transmissions will avoid causing harmful interference to radio astronomy operations, especially in the case of NGSO satellites transmitting directly into radio astronomy receivers as they orbit over such facilities.

The protection requirement for radio astronomy, prescribed in Recommendation ITU-R RA.769-1, is defined as an average integrated over 2000 seconds. This is important for NGSO FSS systems having satellites that move through the field of view of the radio astronomy receiver, taking advantage of its discrimination most of the time.

The means used by NGSO FSS operators to protect radio astronomy will vary from system to system. SkyBridge plans to have a 85 dB rejection filter in the radio astronomy band. With a noise power ratio (intermodulation noise) of

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207/ (...continued)
emissions. The accuracy achieved is significantly below 10 kHz for space stations, gateways, and user terminals, in compliance with Section 25.202(d) and (e). SkyBridge will also meet the emission limitations of Section 25.202(f).

208/ NPRM, ¶ 82. The Commission computes that in order to protect radio astronomy receivers, the aggregate power flux density from all NGSO satellites in a constellation would have to be below -255 dBW/m^2/Hz in the 10.68-10.7 GHz band. See Rec. ITU-R RA.769.1.

18 dB, a 103 dB rejection over the SkyBridge signal will be obtained in the radio astronomy band. Such levels will ensure the protection of radio astronomy receivers at the levels defined in Rec. ITU-R RA.769-1 in the band 10.68-10.7 GHz.

3. RF Hazard

The Commission has requested comment on ways to ensure that NGSO FSS systems, in particular ubiquitous subscriber earth stations, can comply with the RF safety guidelines required under Section 1.1307(b), including who (satellite operator, service provider, or manufacturer) should ensure that the radiation hazard provisions are being followed.[209/] The Commission has also asked whether it should impose appropriate labeling requirements on the subscriber terminals.[210/]

SkyBridge agrees that such safety concerns are of the utmost importance. From a regulatory standpoint, the procedures to ensure that the Commission's safety standards are met are already in place. Under Section 1.1307(b), an Environmental Assessment would need to be filed with any application for earth stations that would cause human exposure to RF radiation in excess of those specified in Section 1.1310.[211/] At the Commission's request, applicants are required to make a technical showing demonstrating how compliance will be achieved.

Therefore, manufacturers will need to conduct thorough tests to ensure that earth stations comply with the limits. Based on preliminary calculations,

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209/ NPRM, ¶ 83.

210/ Id.

211/ In the case of the user terminals, gateway operators presumably will seek blanket authority to market these terminals, thereby affording the Commission an opportunity to make an appropriate case-specific judgment.

SkyBridge believes that its user terminals will comply with the requirements, without requiring additional measures. If necessary, however, a variety of methods could be used by NGSO FSS earth station manufacturers and/or distributors to ensure compliance with these safety requirements, even when the earth stations are operated in residential and business environments. These may include detailed installation and warning instructions, or may include technical features, such as detectors that sense the approach of a person. In any case, it should be up to the party applying for the earth station license or marketing authorization to demonstrate that the subject equipment meets the relevant standards.

VIII. NGSO FSS LICENSING RULES

In addition to the basic licensee qualifications discussed supra in Section VI.B, SkyBridge agrees with the Commission that the following requirements also should be imposed on Ku-band NGSO FSS applicants and licensees.

A. Coverage Requirement

The Commission proposes to apply to NGSO FSS systems in the Ku-band the same geographic coverage requirements that it applies to other NGSO satellite services intended to provide global coverage, in order to further the creation of a seamless global telecommunications network.[212/] Specifically, the Commission proposes to require that Ku-band NGSO systems be capable of serving locations as far north as 70° latitude and as far south as 55° latitude for at least 75% of every 24-hour period, and to provide continuous service throughout the fifty states, Puerto Rico, and the U.S. Virgin Islands.[213/]

SkyBridge fully supports the Commission's proposed coverage requirement. Indeed, the primary reason WRC-97 decided to facilitate NGSO FSS entry into the Ku-band was to ensure development of truly global services. WRC-97 adopted Article S22 in order to further the ITU's mission of promoting the extension of "new telecommunications technologies to all the world's inhabitants."[214/] In doing

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212/ NPRM, ¶ 84.

213/ Id. These are the same rules that the Commission applies to the "Big LEO" systems operating in the 2 GHz band, and the NGSO FSS systems operating in the Ka-band. Id.

214/ Resolution 130 (WRC-97, Geneva), considerings a; quoting from No. 6 of the Constitution of the International Telecommunication Union (Geneva, 1992).

so, it emphasized the urgent need for systems capable of providing universal service, and the ability of NGSO system to provide the most isolated regions of the world with high-capacity and low-cost means of communication.[215/] While furthering the intent of the ITU, the proposed coverage requirement will also benefit the American public, ensuring provision of service to all corners of the United States, consistent with the mandate of Section 706 of the '96 Act.

B. Financial Qualifications

Through numerous rulemakings intended to authorize innovative commercial satellite services, the Commission has stressed the importance of financial qualification requirements.[216/] Financial qualifications have been essential to promote efficient use of scarce radio spectrum. As the Commission has noted, undercapitalized companies have difficulty raising the billions of dollars needed to finance a viable global NGSO broadband satellite system and could tie up valuable orbital resources for years.[217/]

In this proceeding, the need for strict financial standards is obvious. The Commission has already received a number of applications for Ku-band NGSO FSS systems, ranging in cost from $1.9 billion to $6.95 billion. In order to prevent frivolous filings and limit assignment of scarce spectrum to those who are capable of

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215/ Resolution 130 (WRC-97, Geneva), considerings b), e), and j).

216/ See, e.g., Big LEO Proceeding; DISCO II Order.

217/ DISCO II Order at ¶ 157.

using it, the Commission should apply the strict financial standard adopted for the Big LEO proceeding, as it has proposed.[218/]

C. System License and License Term

SkyBridge supports the Commission's proposals to provide a blanket license for all technically identical satellites, and adopt a 10-year license term, running from the date on which the first space station in the system begins transmissions.[219/] SkyBridge also agrees with the Commission that the current filing window for replacement satellites is appropriate, and should be applied to Ku-band NGSO FSS systems.

D. Implementation Milestones

Implementation milestones are needed as much as financial requirements, to ensure that licenses are only granted to those who are able to, and do, use the license to provide service to the public. The Commission has proposed a milestone schedule requiring the entire authorized system to be operational within six years, based on the timetables that currently apply to NGSO MSS systems.[220/] SkyBridge supports this proposal, which will help realize the Commission's commitment to provide effective broadband capacity to all Americans.[221/]

218/ NPRM, ¶ 85.

219/ NPRM, ¶86.

220/ NPRM, ¶87.

221/ See Section 706 Report.

E. Reporting Requirements

SkyBridge supports the Commission's decision to require annual reports from licensees describing the status of satellite construction and anticipated launch dates, including any major delays or problems encountered; a listing of any unscheduled satellite outage of more than 30 minutes, including the cause(s) of such outage; and a detailed description of the utilization made of each satellite in orbit.[222/]

F. Exclusive Relationships in Foreign Countries

The Commission has prohibited satellite licensees from entering into any arrangement which would establish one particular satellite service provider as the only permissible facility by which to offer a particular satellite service between the United States and a foreign country.[223/] This prohibition is based on sound public policy of facilitating global competition by furthering the use of multiple satellite systems and ensuring that U.S.-licensed systems can provide global coverage.[224/] SkyBridge fully supports adoption of this prohibition against exclusive arrangements.

G. Sale of License

SkyBridge supports the Commission proposal to prohibit any Ku-band NGSO licensee from selling a bare license for a profit.[225/] As the Commission has

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222/ NPRM, ¶ 88.

223/ NPRM, ¶ 89.

224/ DISCO II Order at ¶ 161.

225/ NPRM, ¶ 90.

previously noted, this provision is needed to discourage speculation and prevent unjust enrichment of those who do not implement their proposed systems.[226/]

[226/] Big LEO Proceeding at 6014.

IX. NORTHPOINT

The Commission has requested comment on the Petition for Rulemaking filed by Northpoint Technology ("the Northpoint Petition") to permit operation in the 12.2-12.7 GHz band "on a secondary, shared, non-interference basis to transmit video entertainment material, data and other communications traffic related to the operation of . . . DBS system[s]."[227/] As demonstrated below, there is no rational reason for reintroducing any terrestrial service in this band, let alone one such as Northpoint, which will interfere with ubiquitously-deployed user terminals for satellite services allocated in this band. The Commission should decline Northpoint's request.

A. Northpoint's Proposed Service

As an initial matter, it is not at all clear what sort of service Northpoint is proposing at any given moment. The Northpoint Petition proposes to allow "DBS affiliates to re-use the DBS band in order to distribute local television signal and deliver broadband digital data."[228/] However, the 69 applications filed by various Northpoint affiliates on January 8, 1999 (the "Northpoint Applications") contain no evidence whatsoever of any affiliation with any DBS licensee. It appears that Northpoint has abandoned the proposal outlined in its Petition, which -- in theory -- would have enabled DBS operators to supplement their own service, and now

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227/ Petition for Rulemaking to Modify Section 101.147(p) of the Commission's Rules to Authorize Subsidiary Terrestrial Use of the 12.2-12.7 GHz Band by Digital Broadcast Satellite Licensees and Their Affiliates, RM-9245, March 6, 1998 ("Northpoint Petition"), Attachment A; see also Public Notice, Report No. 2265, March 23, 1998.

228/ Northpoint Petition at 1.

proposes instead to enter the terrestrial wireless broadband access market, apparently offering local television channel distribution as an essentially ancillary service.[229/] This change in marketing plans is not surprising, given the universal opposition of DBS licensees to the Northpoint Petition, even when the proposed service was at least ostensibly intended for their benefit.[230/]

This raises serious questions regarding the basic rationale underlying Northpoint's proposal, setting aside for the moment the obvious technical flaws in its "system." According to its original proposal, the Northpoint service would essentially "piggy-back" off the existing DBS services; this was the sole reason given by Northpoint for needing access to the 12.2-12.7 GHz band. This symbiotic relationship was a critical element of the plan, which turned on Northpoint's ability to gain access to customers' DBS receivers. Without such access, there is no reason for Northpoint to use the 12.2-12.7 GHz band, and, as demonstrated infra, there are myriad technical reasons why it should not.[231/]

229/ Among the services described in the Northpoint Applications are "Internet services." It is not clear how such services will be provided with Northpoint's receive-only user terminals (unless via telephone line).

230/ See DirecTV Opposition; Primestar, Inc. Opposition; EchoStar Communications Corporation Opposition; Tempo Satellite, Inc. Comments; and USSB Comments, RM No. 9245, filed April 20, 1998. All of these DBS providers stated that Northpoint has failed to show that its system can co-exist with the DBS service without causing unacceptable levels of interference.

231/ Even if current DBS hardware could accommodate the Northpoint signals, Northpoint could not access those boxes without the consent of the DBS providers. Because Northpoint now appears to have abandoned its symbiotic strategy, and because DBS operators believe they will be subject to interference from Northpoint, such cooperation is unlikely.

In fact, Northpoint's newest proposal -- which concentrates more on broadband data services than local television station distribution -- is nothing more (and, as a one-way service, is substantially less) than LMDS, MMDS, or DEMS by another name. The Commission has already allocated sufficient spectrum for these services in, inter alia,.the 2.5 GHz, 24 GHz, and 28 GHz bands. Northpoint has provided no justification whatsoever for adding an additional allocation in a band that is already heavily used by BSS operators and that has been allocated on an international basis to NGSO FSS operators, especially given the interference concerns articulated by those satellite systems.[232/]

B. Sharing Between NGSO FSS and the Northpoint Service

Northpoint seeks to enter a band already heavily used by, and earmarked for additional, satellite services, yet its filings with the Commission have been completely devoid of the information required for any party (whether NGSO FSS or DBS) to conduct a definitive interference analysis. For whatever reason, Northpoint continues to fail to provide the basic technical parameters regarding its proposed system necessary to conduct sharing studies with either DBS or NGSO FSS systems.

These same concerns were raised internationally in two ITU forums: the JTG 4-9-11 meetings held in Toulouse in July 1998, and a 9A Correspondence Group meeting held in Long Beach during the JTG 4-9-11 meeting in January 1999.

232/ Furthermore, there is no justification for making Northpoint secondary only to BSS, but co-primary with NGSO FSS, as Northpoint proposes. See NPRM, ¶ 91, n.157. BSS and NGSO FSS are co-primary internationally, and the Commission has proposed to make them co-primary domestically in this proceeding. For the reasons given above, there is no basis for distinguishing between the two vis-a-vis Northpoint.

At those two meetings of international technical experts, a paper describing the Northpoint system was submitted for consideration and rejected, in large measure because, based on the few system technical parameters provided, these technical experts were unable to conduct any meaningful analysis of the Northpoint system. Moreover, the few technical parameters that were submitted were patently lacking in credibility. For example: the system noise floor proffered by Northpoint bore no relationship to the requirements of any viable FS system; the stated performance objectives had no demonstrable justification; and, as a consequence, there were no valid protection criteria available to be used in any sharing studies, particularly with regard to NGSO FSS downlinks.

Another problem with Northpoint is that the very few technical parameters it is willing to reveal keep changing without explanation. For example, the maximum transmit EIRP of the system is given as 45 dBm (15 dBW) in the January 8, 1999 Northpoint Applications, whereas in the ITU contributions described above,[233/] the EIRP is in the range of -21.5 to -7.5 dBW, with a typical value of -17.5 dBW. Northpoint offers no explanation for this astonishing discrepancy.

Nonetheless, SkyBridge has taken what little data is available, in an effort to assess the feasibility of sharing between NGSO FSS systems and the proposed Northpoint service. This analysis is set out below.

233/ See Documents 4-9-11/88 and US RCG 9A-Int/1(R5).

1. Interference to Northpoint Subscriber Antennas from NGSO FSS Systems

Northpoint has questioned whether the WRC-97 PFD limits would protect its proposed service from interference from NGSO FSS systems.[234/] As the Commission is well aware, establishing appropriate PFD limits depends primarily on an assessment of the criteria needed to afford the terrestrial system adequate protection. To date, Northpoint has simply claimed that it needs certain rather extraordinary protection criteria,[235/] but has never offered a shred of justification for them.

Northpoint's proposed criteria seem to be derived from the wildly optimistic performance/availability objectives that the system is claiming: system availability between 99.7% and 99.95%, with a typical value of 99.9%; a fade margin of 3 dB and a service distance between 10 and 20 km (typical value of 16 km). Put simply, it is beyond optimistic to expect such high performance/availability for a terrestrial system with only 3 dB fade margin over such a wide service area at those frequencies. Northpoint appears to ignore the high fade margins required for FS point-to-point systems; standing alone, the multipath fading common in this frequency range appears to undermine Northpoint's assumptions.[236/]

234/ NPRM, ¶ 96.

235/ Northpoint's most recent ITU submissions claim the following: long-term: I/N = -13 dB not to be exceeded for more than 20% of the time, short-term: I/N = 0 dB not to be exceeded for more than 0.001% of the time.

236/ Moreover, Northpoint's claimed protection criteria have not been derived using an internationally recognized methodology such as was developed by WP 9A for deriving FS point-to-point systems protection criteria in the 10.7-

(continued...)

In short, there is no valid technical reason for Northpoint to claim a more stringent protection criteria than point-to-point FS systems, particularly given that the latter have considerably higher performance/availability objectives and that, as noted above, the allowable degradation from interference is directly linked to the performance objectives of the system. It seems clear that if Northpoint is accorded a technically rational level of protection, the PFD limits recently approved by the JTG would fully protect the Northpoint system.

2. Interference to NGSO FSS Subscriber Earth Stations

As demonstrated above, there is no reasonable concern regarding interference to Northpoint from NGSO FSS systems; the existing PFD limits are more than adequate in that regard. However, it seems equally clear that NGSO FSS systems will suffer significant interference from a Northpoint system. Because the 10.7-11.7 GHz band is restricted to gateway operations to facilitate sharing with FS systems, the 11.7-12.7 GHz band must be used by NGSO FSS operators for ubiquitous user terminals. As the Commission is well aware, sharing among ubiquitous satellite earth stations and high density point-to-multipoint terrestrial

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236/ (...continued)
11.7 GHz band. This methodology is based on the degradation of the FS Error Performance Objectives (EPO) allowable to interference from systems operating co-primary (10%) and on the probability to have simultaneously short-term interference and fading on the FS link. Whatever Northpoint's ultimate justification, its claims must be tested using universally accepted methodologies.

systems presents an intractable problem. Indeed, the Commission has detailed the problems inherent in such proposals in multiple proceedings.[237/]

Northpoint proposes a high-density service. Although the lack of information on the Northpoint transmitters means that the geographic extent of the interference they will cause to NGSO FSS systems cannot be definitely quantified, SkyBridge's preliminary computations indicate that each Northpoint transmitter will create a substantial area in which NGSO FSS user terminals cannot operate. As each Northpoint service area is only on the order of 16 km in diameter, several such transmitters would be needed to ensure reasonable coverage of even a small television market. It therefore appears that NGSO FSS service would be precluded in significant portions of any market served by a Northpoint system.[238/]

237/ See, e.g., Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services, 11 FCC Rcd 19005 (1996); Amendment of the Commission's Rules to Relocate the Digital Electronic Message Service From the 18 GHz Band to the 24 GHz Band and to Allocate the 24 GHz Band for Fixed Service, 13 FCC Rcd 15147 (1998).

238/ The situation is similar for DBS operations. In fact, were Northpoint to operate at the maximum powers specified in its FCC applications (45 dBm EIRP), SkyBridge's preliminary calculations indicate that DBS receivers over nearly the entire Northpoint service area would receive harmful interference. Presumably recognizing this difficulty, Northpoint states that such power would only be used in areas where DBS services do not currently exist. However, U.S. DBS licensees are authorized to provide service to all areas of the U.S. Operation of Northpoint at such powers would preclude introduction of authorized DBS services, and would be inconsistent with the purpose of the Northpoint system stated in its Petition, i.e., to be a supplement to DBS service, re-using DBS equipment.

C. There is No Basis for Licensing a Northpoint-type Systems at Ku-band

SkyBridge is sympathetic to the dilemma currently confronted by DBS consumers regarding reception of local broadcast signals. It is a problem that makes Northpoint's misleading claims of a simple solution seem attractive to those who do not have to wrestle with technical reality. That attraction is, however, an illusion. For the Northpoint system to provide any reasonable level of service, it would cause devastating interference to both DBS and NGSO FSS services in the 12.2-12.7 MHz band. Moreover, the system -- even assuming arguendo that it could be made to work -- does not solve any problem for DBS consumers that cannot be solved far more easily through other means. DBS systems have the technical capacity to provide service far superior to Northpoint's best case (unproven) scenario, without the threat to other services posed by Northpoint. Legislation is now pending in Congress with seemingly universal support that would enable DBS licensees to utilize their relevant technical capabilities.[239/] There is, quite simply, no technical or policy rationale that supports Northpoint's proposal, particularly given the fact there is considerable alternative spectrum (e.g., 2.5 GHz, 24 GHz, 28 GHz) available to accommodate Northpoint's broadband service plans.

239/ Indeed, Northpoint itself would appear to need legislative relief from Congress -- i.e., a compulsory copyright of the sort granted to cable television systems -- before it could begin distributing local broadcast signals (unless it wished to negotiate copyright licenses with each local broadcaster).

X. INTERIM PROCEDURES

If the Commission is to achieve the goals established by Section 706 of the '96 Act and WRC-97, it must proceed as expeditiously as practicable to establish the necessary regulatory framework and license qualified applicants. Obviously, there are substantial reasons to await the outcome of WRC-2000 to finalize certain of the technical rules here under consideration, but that fact need not impede progress on other matters.

First, the Commission should immediately direct all Ku-band NGSO FSS applicants to initiate technical discussions within the next thirty (30) days to: (1) determine the extent, if any, of mutual exclusivity among those applicants; and (2) devise a technical solution that would allow all qualified applicants to proceed. In parallel with such discussions, the Commission should begin international coordination of these systems. Contemporaneously, the Commission should issue a Public Notice regarding the acceptability for filing of the pending Ku-band NGSO FSS applications, conditioned upon whatever qualification, service and technical rules ultimately may be adopted.

Second, as soon as the reply comments in the proceeding are closed, the Commission should begin to formulate the NGSO FSS licensee qualification and NGSO-NGSO sharing rules described supra, with a goal of adopting those rules in a First Report and Order to be issued no later than the end of the second quarter of 1999. The ongoing technical discussions described in the immediately preceding paragraph should proceed to a rapid conclusion shortly thereafter. Indeed, the

Commission should direct the parties to conclude their negotiations by the end of the third quarter of 1999.

Third, the Commission should issue licenses -- presumably consistent with the above-described negotiated solution -- by the close of 1999; obviously licensees would need ultimately to comply with whatever final technical and service rules were adopted. Given the need for variable power control and similar features in any viable Ku-band NGSO FSS system, this should not present a significant problem.[240/]

Finally, as soon after the conclusion of WRC-2000 as is practicable, the Commission should conclude this proceeding by adopting a Second Report and Order establishing the necessary technical regulations for NGSO FSS operating at Ku-band.

The beneficial effects of proceeding according to the above described schedule are manifest. First, obviously, the applicants are able to move forward as quickly as possible, consistent with the goal of Section 706 and WRC-97. Additionally, it will quickly become apparent which, if any, of the existing NGSO FSS applicants are either not qualified or not serious about actually constructing and operating a Ku-band NGSO FSS system; their expedited departure from the process will ease the path for the remaining serious applicants.

240/ As has been noted elsewhere, SkyBridge will be beginning initial construction of its satellites in the near future (and will formally notify the Commission thereof pursuant to 47 C.F.R. § 25.113(f) at the appropriate time). This lead time is needed to enable SkyBridge to meet its 2001 in-service target.

Second, by licensing some number of Ku-band NGSO FSS applicants six months or so prior to WRC-2000, the Commission will be well-positioned to significantly influence the relevant outcome of that Conference. This, in turn, will greatly ease the Commission's task of adopting its own final rules and in ensuring the smooth operation of the sharing regime in the future.

Given the critical timelines that confront the Commission under both the mandate of Section 706 and the need to properly prepare for WRC-2000, adoption of the above described interim procedures is vital. The needs of the serious NGSO FSS applicants will be met; the legitimate interests of the GSO and FS parties will be protected; and, most importantly, the overarching public interest in establishing universal access to high speed, interactive broadband service will be greatly advanced.

CONCLUSION

The Commission has before it in this proceeding a rare opportunity. It can expedite the attainment of the U.S.'s longstanding goal of a universally available global information infrastructure, the satellite components of which can be in operation within the time frame announced by Vice President Gore last October. It can extend and strengthen the U.S.'s historic role as the world leader in promoting the competitive provision of satellite services. It can materially enhance the efficiency with which scarce satellite orbital and spectrum resources are used.

The Commission can accomplish these things while preserving existing GSO and FS Ku-band services and ensuring their continued opportunity for growth. As the JTG continues to assay the technical issues presented, it becomes more and more apparent that existing GSO and FS operators are gaining confidence that their legitimate interests will not be threatened by the introduction of Ku-band NGSO FSS systems. This process will continue and, as is usually the case with the introduction of new technologies, the free exchange of unvarnished technical information ultimately will ensure that all legitimate concerns are fully explored and resolved.

Thus, the Commission should proceed to adopt the regulatory regime described above at the earliest opportunity. While the final determination regarding certain technical issues identified above should not be made until the ITU process has been concluded, it can be said with confidence at this juncture that that process will conclude successfully and that NGSO FSS systems will operate at Ku-band in the

relatively near future. The public interest will be greatly served to the extent that the Commission can use this proceeding to expedite the realization of that goal.

Respectfully submitted,

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March 2, 1999